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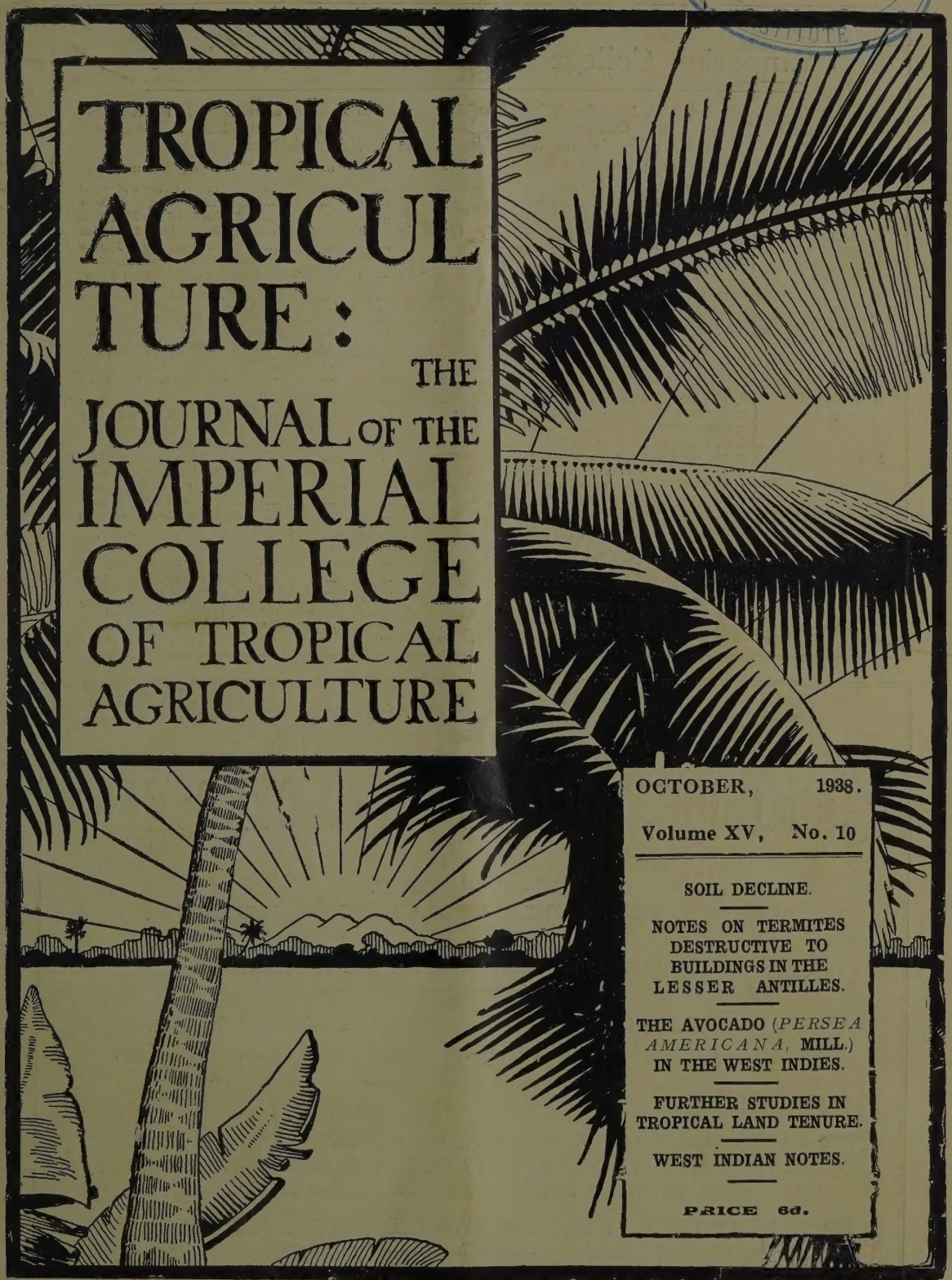

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Volume XV, No. 10

SOIL DECLINE.

NOTES ON TERMITES DESTRUCTIVE TO BUILDINGS IN THE LESSER ANTILLES.

THE AVOCADO (*PERSEA AMERICANA*, MILL.) IN THE WEST INDIES.

FURTHER STUDIES IN TROPICAL LAND TENURE.

WEST INDIAN NOTES.

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SOIL DECLINE.*

As Influenced by Various Factors.

THE objective of soil science is to maintain or to increase the productive capacity of the soil, and all sound farming practice should be directed to that end. First should be considered the effect of continuous cultivation on a hypothetical farm. The effect of the vegetative cover of virgin soils has been to retard the loss of plant nutrients, to build up the organic matter content, and to anchor the soil in place. The return of plant residues maintained the mineral matter near the surface, and the deeper roots penetrated into the subsoil and minimised the escape of nutrient substances; the fibrous root-mass functioned as myriads of minute brush dams, minimising erosion. The most extensive areas of soils of high fertility, *viz.* the chernosem of Russia and the prairie soils of North America, have developed under a grass and herbage vegetation. Under a grass vegetation, a tough mass of fibrous roots completely ramifies within the surface soil, producing a granular crumb structure which is ideal for crop culture. Such a structure develops best in a soil well supplied with lime and organic matter. These two ingredients alone will not produce an ideal soil structure, for structional development demands, in addition, an undisturbed perennial vegetation.

To grow the annual crops which the farm economy demands, tillage operations must be carried out, temporarily loosening the soil and producing an effect called "good tilth". All available evidence indicates that the effect of tillage is to accelerate the destruction of the granular structure which slowly develops in undisturbed soils. Every time an implement is forced through the soil, countless granules are crushed, and the particles composing them take up new positions, or are forced into the pores between the remaining granules, thus diminishing water movement and aeration. When forest or grassland soils are ploughed, the mass of roots absorbs part of the stress of the tillage processes and the soil has a springy, spongy structure which prevents its compacting under beating rain. Under cultivation, the plant residues are oxidised, the granules destroyed, and up to 25 per cent. more soil is crammed into a cubic foot than under natural vegetation.

* Adapted from *The Australian Sugar Jr.*, Vol. 29 No.9, pp. 543-4, 1937. An address by N. H. Parbury reported in *The Agric. Gazette, N.S.W.*

The substitution of annual for perennial plants does not permit long enough contact by the roots to help to stabilise the structure. The growing season of the annuals is shorter, the root systems less extensive and of lower tensile strength, and the roots decompose more readily than those of perennial crops. Experience on farm and experiment station the world over demonstrates that *the most feasible way of maintaining soil structure is by combining arable agriculture with grass-land farming.* Respite from cultivation should not occur only when arable soils have been worked to the point of exhaustion. This defeats the desired object, in that the soil will no longer support a flourishing grass-legume cover.

Soil decline under humid conditions is continuous, and is brought about by the natural processes of soil development; its rate is accelerated by large-scale agricultural operations or intensive grazing. In general, the changes effected by the climatic processes are more far reaching and less amenable to correction than man-induced changes, whether by farming or grazing. Soils vary in productive capacity when first cultivated; the cropping life of some covers but a few years; soils in general are incapable of being brought up to equally high productive levels by any feasible soil improvement methods. Soils exhibit physical and chemical characteristics which are related to the materials from which they were derived and to the climatic conditions to which they have long been subjected. The amount of exploitation which the soils of a farm will tolerate before the production level is spectacularly reduced depends in a large measure on their original chemical status, provided physical conditions are satisfactory. But every grazing animal, every gallon of milk or bushel of grain sold off the farm, and every gallon of percolating water, removes a portion of the never-too-abundant supply of plant food; hence, in a few generations, arable soils begin to fail, an undesirable plant association composes the pastures, and the stock become unhealthy. It will thus be seen that, in the humid regions, the basic factor in the destruction of soil resources is depletion of plant nutrients. Erosion provides the dramatic climax, the ultimate result, but not the fundamental cause.

Leguminous crops are spoken of as soil renovators, and undoubtedly leave the soil in admirable condition for a succeeding crop of a relatively low mineral-demanding plant such as maize. Against this result must be weighed the heavy drain of calcium, magnesium, potassium, nitrogen and phosphorus by the leguminous crop, and actually the sum effect is a further degree of soil impoverishment. The final process in "wringing the last drop" from declining soils is the utilisation of poor land crops. The outcome of the practice of choosing poor land crops to suit a soil as it becomes impoverished, unattended by liming, manuring and fertilizing, is certain to have serious consequences. Poor land crops mean poor quality crops; the soil and the farmer become impoverished beyond redemption by his own resources.

The tendency of the vegetative cover under acidic soil conditions is to concentrate potassium, lime, phosphorus and organic matter in the surface soil. Herein also is the greatest concentration of crop roots, and since the subsoil becomes depleted of usable phosphate by the deeply penetrating roots, the phosphate concentration in the surface soil becomes largely the determining factor in the cropping capacity of the soil. Phosphate is the most sought in the partnerships into which the basic elements of the soil enter. Its freedom is restricted by lime in alkaline soils, and in acidic soils it is preyed on by aluminium and iron and effectively imprisoned. Hence, phosphate, if not originally a limiting factor, is the first nutrient required to be added if production is to be maintained. Fertilising with superphosphate is the "romper" stage in fertiliser practice, and while it often gives spectacular results, the farmer cannot expect it to produce equal results indefinitely. By restoring the plant nutrient balance, it enables further exploitation of the other soil nutrients, one of which finally appears in the rôle of a limiting factor. The use of complete fertilisers provides the major nutrient requirements of plants in an available form. Their cost rules them out of consideration with large-area crops, such as wheat, but they are either desirable or essential under conditions of intensive culture, such as horticulture, orchard and vegetable culture, and small-farm cash crops. The field of complete fertilisers is being further extended by the addition of basic lime compounds which counteract the acidifying effect of certain fertilisers, such as ammonium sulphate. A point is finally reached, even with good fertiliser practice and crop management when complete fertilisers fail to produce satisfactory returns. A number of minor elements are now recognised as essential, and in their absence, definite disease symptoms are produced. Such effects are common in soils long employed in agricultural production, and deficiency diseases, due to lack of manganese, magnesium, boron, copper and zinc, have been recognised. Green manure crops are utilised in farm practice:—(1) to increase the supply of nitrogen, for which purpose a number of legumes are used; (2) to conserve the substances which would be leached in the absence of a crop; (3) to replace losses of organic matter.

Admirable in the above rôles, green manure crops, in effect, are the "kitchen-staff" for succeeding crops. The latter have the advantage of the foraging and the preparation of nutrients by a previous crop, as well as that gained on their own account. This system maintains production for a time, but the result, again without the introduction of judicious fertiliser practice, particularly on the less fertile soils, is

an accelerated rate of mineral loss, resulting in increased soil acidity and the train of undesirable effects which attend this condition. Satisfactory crops and their complete return to the soil are necessary in order to compensate for the loss of organic matter which is accelerated by cultivation. The humus left by the decomposition of green crops is not sufficient to replace this loss completely. When cowpeas were grown on a soil and the whole crop turned under annually, a loss of one ton of humus per acre was recorded after twenty years of this treatment. When only the stubble from a cowpea crop was turned under, the loss after twenty years amounted to 5,000 lbs. humus per acre. Legume residues, such as cowpea roots and stems, when ploughed in, may depress a succeeding crop, due to the soil nitrogen being used up in their decomposition. This depressing effect is not so great as that induced by a mature non-legume material, such as cereal straw, corn stalks, sorghum roots, and cane-trash. The age of the plant at the time it is used for green-manuring exerts an important influence on the amount and rapidity of liberation of the nutrient elements in an available form, and upon the quality and amount of humus produced.

A system of arable farming exerts an effect on the number and activity of useful or harmful organisms. The micro-organism *Azotobacter* is typically associated with soils of good lime and phosphorus content, and possesses the important ability of increasing the nitrogen content of the soil. Its general absence from wheat areas indicates that they are receiving little or no gratuitous nitrogen, and that the crops are merely drawing on the nitrogen capital of the soil accumulated over centuries. Too great a degree of acidity appears to be the contributing factor over large areas. Another important soil phenomenon may be classed in the group of processes leading to soil deterioration, namely, the formation of "sick" or "exhausted" soils. This is frequently due to an accumulation of fungi, bacteria and protozoa, parasitic upon the crop plants or upon the micro-organic population. The phenomenon of soil fatigue, caused by the accumulation of a bacteriophage or bacteria-destroying substance, results in the destruction of the specific bacteria concerned in the formation of nodules. A measure of control of the micro-organic population is attained by the use of legume bacteria cultures, and control of disease organisms by (1) rotation of crops; (2) resistant varieties; (3) elimination of parasites from the soil by special treatment; and (4) modifying the soil reaction or organic matter content to render the conditions unfavourable to the pathogen. Any system of soil improvement or conservation must therefore consider the influence of soil treatment upon the activities of the soil-inhabiting micro-organisms, as well as utilising their activities in order to promote permanent systems of agriculture. The farmer is the trustee of the soils he utilises, and unless the system of farming contributes permanently to the maintenance or building-up of that trust, it is unprofitable to himself and to society.

VEGETABLE OILS AND OILSEEDS.

ACCORDING to a review on the "Vegetable Oils and Oilseeds"* issued by the Imperial Economic Committee the use within the five years 1932 to 1936, of vegetable oils for soap making has increased rapidly, mainly because of the larger proportion of palm oil used. The use of animal fats such as tallow declined. In the margarine industry, the main development has been the increasing use made of whale oil at the expense of the vegetable oils. For compound lard, the chief ingredient is still cottonseed oil, but this has declined in relative importance and a bigger proportion of whale oil has been used.

The review, which deals with the world production and trade for those oilseeds and nuts of chief commercial importance indicates that a well maintained demand in Europe and America and a marked improvement in prices were the outstanding features of the world oilseed situation in 1936. In 1937, oilseed prices fluctuated downwards. Both in 1936 and 1937 the influence of the United States on world markets was important; but, whereas in 1936 the severe drought contributed to the rise in world prices, in 1937 the expectation of bumper crops had the reverse effect.

By weight, soya beans, linseed, ground nuts and copra are, in that order, the chief oilseeds and nuts entering international trade. Cottonseed and palm kernels are of considerable, though lesser, importance and palm oil is the principal oil. Production figures, which for many oilseeds are incomplete, suggest that world crops were larger in 1936-37 than in the previous year. Exports, which commonly account for a relatively small proportion of the total output, were larger in 1936 than in 1935 for all the chief oilseeds and nuts, except linseed and cottonseed.

None of the Empire countries, except the United Kingdom, is a large importer of oilseeds. It is noteworthy, however, that India, despite its large output of coconuts and various oilseeds, has in recent years become the chief Empire importer of coconut oil and has also taken increasing quantities of copra from the neighbouring countries. On balance, the British Empire exported to the rest of the world in 1936 much larger quantities of ground nuts and palm kernels than in 1935 and imported smaller quantities of cottonseed, linseed and soya beans.

* Price 2*s.* 6*d.* net, 2*s.* 9*d.* post free.

NOTES ON TERMITES DESTRUCTIVE TO BUILDINGS IN THE LESSER ANTILLES

By A. M. Adamson
(*Imperial College of Tropical Agriculture*)

I. Introduction

During the past five years, I have had an opportunity of studying and collecting termites in many of the Lesser Antillean Islands, for periods ranging from several years in Trinidad to a few hours spent ashore on some of the smaller islands while travelling in Caribbean waters. Further collections of termites attacking buildings have been received from Mr. R. W. E. Tucker in Barbados, Mr. R. G. Fennah in St. Lucia, Mr. C. G. Munro in Grenada and from Mr. H. E. Hinton made during a short visit to Tobago. In the list of records given below, the names of these collectors are entered, and I take this opportunity of thanking them. I am indebted also for facilities for field-work to Mr. Tucker in Barbados, Mr. W. O'B. Donovan and Mr. C. G. Munro in Grenada, Mr. C. K. Robinson and Mr. C. C. Seale in St. Vincent, Monsieur D. Kervégant in Martinique, and Monsieur H. Stehlé in Guadeloupe. My visit to St. Vincent in June 1938 was for a general entomological investigation at the request of the Commissioner of Agriculture for the Leeward and Windward Islands, Mr. G. A. Jones, to whom I am grateful for this privilege.

Except for a few records of the occurrence of termites, scarcely anything has been published about the termite problem in the Lesser Antilles. I have already written a preliminary report (1937) on the termites of Trinidad, and now offer some brief notes on those of greatest economic importance in other islands. The most important results presented are the records of the destructive dry-wood termite, *Cryptotermes brevis* (Walker), and the subterranean *Heterotermes tenuis* (Hagen), in all of the islands where an adequate search was made, and the records from Barbados, Grenada and Tobago, as well as from Trinidad, of the notoriously destructive *Coptotermes*, a genus previously almost unknown in the West Indies.

The termite fauna of Trinidad is rich and varied, with probably well over 60 species, most of which occur also on the South American mainland, of which Trinidad was until geologically recently a part. In the neighbouring island of Tobago, the fauna, though much less extensive than that of Trinidad, is probably similar in many general features. In Grenada and northwards, however, a great reduction in the fauna occurs, especially in the most highly evolved and most characteristically tropical family of termites, the Termitidae. In St. Vincent, for example, only one member of this family, a common builder of exposed carton nests in the genus *Nasutitermes*, was seen during a short visit in the course of which about six species of the primitive Kalotermitidae were found. In Trinidad a similar amount of collecting would have yielded about the same number of Kalotermitidae but nearly a score of species of the family Termitidae.

In Barbados, which is more oceanic than other Lesser Antillean islands, the termite fauna is still further reduced by the lack of forests to provide a favourable habitat. Moreover, there is little dead wood to be found anywhere, most of it being apparently gathered without delay for fuel. In the only virgin forest of which I learned in Barbados, near Turner's Hall in the northern end of the island, I searched for termites for about two hours and found only the common *Nasutitermes costalis* (Holmgren) and some nymphs of the family Kalotermitidae. In many parts of the island, however, the carton nests of *Nasutitermes costalis* are fairly common, but I saw no other species of the Termitidae in the course of a few hours collecting in several parts of Barbados.

The three most destructive types of termites in the Lesser Antilles are easily recognised. In the dry-wood *Cryptotermes brevis* the workers are elongated, grub-like, slow-moving; the soldiers, which occur in relatively small numbers, have very dark short heads, square in front, to serve for blocking narrow tunnels against invasion by enemies; the winged forms are pale brown and fly by night, in Trinidad usually between 6 and 7 o'clock; the galleries excavated in wood are empty except for numerous hard, seed-like faecal pellets, which may be extruded in large numbers from the infested wood. The soldiers of *Heterotermes* have elongated, yellow heads and dark slender jaws; the winged forms are pale yellow, and in Trinidad they have been found swarming between 7 and 10 p.m.; the galleries of *Heterotermes* in wood are narrow and their walls are lined with cement-like material. In *Coptotermes* the soldiers are very numerous; they have rather rounded yellow heads and slender curved jaws; they are easily recognised by the milky defensive fluid secreted from a pore in front of the head of the soldiers when disturbed; the winged forms of *Coptotermes testaceus* (L.) are black and fly by day; their galleries are wide and often partially filled by large masses of cement-like material.

The builders of exposed nests on tree-trunks, fence-posts, etc., of which the commonest species in the Lesser Antilles belong to the genus *Nasutitermes*, appear to do comparatively little damage to sound wood in buildings. Runways of *Nasutitermes* are not uncommon on wooden houses in or near forest, but whenever I have examined wood invaded by them, it has shown

signs of previous damage by other agents, such as other termites or fungi. These observations are in harmony with those of Light (1933) on *Nasutitermes* (*Subulitermes*) *mexicanus* Light in Colima, Mexico, where these termites "build covered ways over adobe and wood to attack certain portions, possibly only where decayed. How much real damage they cause is not known".

II. List of Records

Cryptotermes brevis (Walker).

Trinidad—Numerous collections, 1933-38 (A.M.A.).

Tobago ?—Nymphs and faecal pellets, probably *C. brevis*, Speyside, April 1936 (A.M.A.).

Grenada ?—Nymphs and faecal pellets, probably *C. brevis*, June 1938 (A.M.A.).

St. Vincent—King, soldiers, &c., Kingstown, 25th Aug., 1936 (A.M.A. 1601*); queen, soldiers, &c., Spring Estate, 27th June, 1938 (A.M.A. 2885).

Barbados—Alates, soldiers, &c., numerous collections, Bridgetown, 1936-37 (R.W.E. Tucker).

St. Lucia—Alates (R. G. Fennah).

Heterotermes tenuis (Hagen).

Trinidad—Numerous collections, 1933-38 (A.M.A.).

Tobago—Soldiers and workers, Speyside, 8th April, 1936, (A.M.A. 918); near mouth of Lambeau River, 7th November, 1937 (H. E. Hinton).

Grenada—Alates, soldiers, &c., near Gouyave, 11th May, 1935, (A.M.A. 500); Dealate female, near Gouyave, 22nd June, 1938 (A.M.A. 2841); soldiers and workers, St. George's, 22nd June, 1938 (A.M.A. 2843); soldiers and workers, St. George's, 19th September and 21st Dec., 1936 (C. G. Munro).

St. Vincent—Alates, soldiers, &c., Kingstown, 25th August, 1936 (A.M.A. 1602) and Belle Isle, 25th June, 1938 (A.M.A. 2875); alates and workers, Kingstown 28th June, 1938 (A.M.A. 2888); soldiers and workers, Kingstown, 23rd June (A.M.A. 2850) and 28th June, 1938 (A.M.A. 2887), and Spring Estate, 27th June, 1938 (A.M.A. 2886).

Barbados—Soldiers and workers, several collections, 1936-37 (R. W. E. Tucker).

Martinique—Soldiers and workers, Fort-de-France 27th September, 1935 (A.M.A. 563 and 564).

Guadeloupe—Soldiers and workers, Pointe-à-Pitre 26th September, 1935 (A.M.A. 552 and 553).

St. Thomas, Virgin Is.—Soldiers and workers, 15th May, 1935, (A.M.A. 516) and 24th September, 1935 (A.M.A. 536).

* Figures following the writer's initials are field-numbers of specimens in his collection.

Coptotermes testaceus (L.)

Trinidad—Numerous collections, 1933-38 (A.M.A.).

Tobago—Soldiers and workers, near Roxborough, 8th April, 1936 (A.M.A. 938 and 939); soldiers and workers, mouth of Lambeau River, 7th November, 1937 (H. E. Hinton).

Grenada—Soldiers and workers, St. George's, 22nd September and 21st Dec., 1936 (C. G. Munro) and 22nd June, 1938 (A.M.A. 2842).

Coptotermes sp.

Barbados—Numerous collections: alates (immature), soldiers and workers, Bridgetown, February 1937; soldiers and workers, 1936-37 (R. W. E. Tucker).

III. Cryptotermes brevis (Walker)

Cryptotermes brevis is the common dry-wood termite in buildings and furniture throughout the West Indies, as well as in parts of Central and South America. It is recorded also in Florida and Louisiana. This very wide distribution is probably due to the ease by which entire colonies may be transported in relatively small objects, such as articles of furniture. It appears to be a domesticated insect, at least in the countries where its habits are known. I have found it on innumerable occasions in buildings in Trinidad, but never outside, whereas related species, in the same genus, have been frequently found in dead trees. I have seen no published record of *Cryptotermes brevis* outside of buildings, and its original natural habitat remains unknown.

In Trinidad, this termite infests more or less extensively almost all wooden buildings and much of the furniture, &c., within them. Buildings free from it, unless recently built, are probably very exceptional. I have seen specimens only from Trinidad, Tobago, Grenada, St. Vincent and Barbados, but have observed considerable damage typical of the work of this species also in other islands and its status through the Lesser Antilles is probably the same as in Trinidad.

IV. Heterotermes tenuis (Hagen)

In all of the Lesser Antilles and many other parts of the West Indies, the most destructive of the subterranean termites appear to be members of the genus *Heterotermes*. Unfortunately, the specific determination of many of them is very difficult, because of the wide variation in distinguishing features of the soldiers, within one species and even in a single colony. The most widely recorded Neotropical species is *Heterotermes tenuis* (Hagen), but, as Emerson (1925) has stated, the records probably apply to more than one species. Descriptions of several New World species have been published by Snyder (1924) and by Light (1933 and 1935), including two in the West Indies, *H. convexinotatus* Snyder from Panama and Cuba and *H. cardini* Snyder from Cuba and the Bahamas. Both Light (1933)

and Snyder (1924) state that further collecting and study may show that some of the New World species are merely sub-species or races within a few widely distributed and variable species.

After a study of both alates (winged individuals of the reproductive caste) and soldiers from Trinidad, Grenada and St. Vincent, and of soldiers alone from Tobago, Barbados, Martinique, Guadeloupe and St. Thomas in the Virgin Islands, I am unable to separate any of the specimens, with certainty, from *Heterotermes tenuis*. All of the alates from Trinidad, Grenada and St. Vincent agree in essential features. Variation among the soldiers, however, is so great that without intermediate forms they would appear to represent at least two species. Most of the soldiers from Tobago, Grenada and St. Vincent agree closely with soldiers from Trinidad, but in all of those examined from Barbados, Martinique, Guadeloupe and St. Thomas the head is smaller and less hairy than in typical specimens from Trinidad.

When more extensive collections, including the reproductive caste, are made in all of these islands, it may be found that more than one species is present. Meanwhile it seems best to refer all the collections from the Lesser Antilles, as listed above, to one highly variable species, *Heterotermes tenuis*.

In Trinidad, *Heterotermes tenuis* is the most ubiquitous termite and the most destructive of the subterranean species. A survey in other islands of the Lesser Antilles will probably show that it has the same ecological and economic status, though I have had an opportunity of observing its attacks on buildings only in Trinidad, Grenada and St. Vincent. Specimens received from Mr. Tucker in Barbados were taken in buildings. Species of *Heterotermes* appear to be the most destructive of the subterranean termites in the New World tropics generally, judging by reports such as those of Light (1933) in Mexico, Snyder (1934) in Panama and the West Indies, and Bequaert (1925) in the Amazon Valley.

V. Coptotermes

The genus *Coptotermes* is probably the most destructive among termites in most parts of the world, especially in Asia. Only three species, however, appear to have been recorded in the New World: *Coptotermes testaceus* (L.)* in South America, including Trinidad; *C. crassus* Snyder described from Honduras and recently recorded in Mexico by Light (1933), and *C. niger* Snyder from Panama. Light's record of *C. crassus* at Colima, Mexico, near latitude 19°N., is the most northerly for the genus in America. It is only within the last two years, so far as I know, that it has been noticed in West Indian islands other than Trinidad, which is of continental origin. Records from Barbados and Grenada, as well as from Trinidad and Tobago, are therefore of exceptional interest.

No sign of *Coptotermes* was found during an hour's search in buildings near the wharf at Kingstown, the capital of St. Vincent, nor during several hours' collecting in other parts of the island. It seems likely that this genus does not extend further north in the Lesser Antilles than Grenada and Barbados, but a thorough search should nevertheless be made in the more northerly islands.

Coptotermes testaceus (L.)

Notes on the economic status of *Coptotermes* in Trinidad have already been published (Adamson, 1937). It is very common in forests, but among scores of buildings attacked by subterranean termites, I have thus far found *Coptotermes* in only four, all others being invaded by *Heterotermes*. To the records of swarming in Trinidad, a recent flight at St. Augustine, on 13th August, 1938, may be added. Flying termites were first noticed at about 5.15 p.m., following heavy rain, and the insects were in the air or running on the ground until about 6.15 p.m. *Coptotermes testaceus* is either native in Trinidad or introduced so long ago that it is now completely naturalised.

In Tobago extensive damage by *Coptotermes testaceus* was observed in a two-storied dwelling house near Roxborough on 8th April, 1936. The supporting framework of the house, which consisted of massive vertical posts and horizontal beams, about eight inches wide in cross section, had been invaded in most parts of the house. At least half of the wood appeared to have been consumed, and the wide cavities were filled with large masses, up to six inches across, of the cement-like material characteristic of this termite. Mr. H. E. Hinton collected soldiers and workers in the dead trunk of a coconut palm near the mouth of the Lambeau River, on 7th November, 1937. From these records it seems probable that *Coptotermes testaceus* is native in Tobago, as in Trinidad, or introduced long ago. I have not yet seen winged *Coptotermes* from Tobago.

The discovery of *Coptotermes testaceus* in Grenada appears to have been made by Mr. C. G. Munro, who sent me soldiers and workers found in an infested lumber shed near the wharf at St. George's in September and December 1936. Mr. Munro was kind enough to show me this infestation on 22nd June, 1938. Only soldiers and workers were found, damaging the walls and supporting posts of pitch-pine, which were being attacked also by a colony of *Heterotermes tenuis*. So far as I know, a thorough search for *Coptotermes* in other parts of Grenada has not been made.

Coptotermes, Undetermined Species.

The discovery of *Coptotermes* in Barbados appears to be due to Mr. R. W. E. Tucker, Government Entomologist, from whom several collections of soldiers and workers from Bridgetown, were received in January, 1937. Further collections made in February and March 1937 include six winged individuals. In all of these the colour is not maturely developed. I have not yet determined the species represented by these

* *C. marabitanas* (Hagen) = *C. testaceus* (L.)

collections but they are distinct from the only three species known to me in the New World, namely *C. testaceus*, *C. crassus* and *C. niger*. It seems unlikely that the relatively meagre fauna of Barbados should include a peculiar species of a genus so poorly represented in other parts of the New World. If it proves to be an immigrant from the Old World, it will be difficult to explain how it reached remote Barbados, without having been established and detected elsewhere. The question of its origin in Barbados is of great interest and economic importance and it is to be hoped that it will be further investigated soon. Of most immediate importance is probably a survey to determine the extent of its occurrence in Barbados.

VI. Control of Termite Damage

The application of standard methods of protecting buildings from termite damage presents many difficulties in the West Indies. In Trinidad many houses are built on high concrete pillars and can be made immune to attack by subterranean termites merely by eliminating wood connecting the building to the ground, and by avoiding any route over which termites can build runways, undetected, from the ground. In most parts of the Lesser Antilles, however, the occurrence of hurricanes limits the use of high pillars, and termite-proof construction of buildings set low on the ground requires skilled and experienced workmanship and considerable expense, beyond the financial resources of the vast majority of the population. For the most costly types of building, however, methods of preventing attack by subterranean termites should be much more widely used than they are now in the Lesser Antilles. It is not sufficiently known that these methods, though adding considerably to the cost of building, result in an ultimate saving of much greater extent in places where subterranean termites abound. For descriptions of methods standardised in other countries, and applicable to West Indian conditions the reader may be referred to works by Kofoid, Light and others (1934) and by Snyder (1935).

VII. Measures to Prevent the Introduction of Termites into Lesser Antillean Islands

The occurrence of certain destructive species of termites on some islands in the Lesser Antilles and not on others raises an important question: are they likely to extend their range and, if so, what measures should be taken to prevent their dispersal? Of greatest importance probably is the presence of *Coptotermes* sp. in Barbados, of *C. testaceus* in Trinidad, Tobago and Grenada, as well as in South America, and of other species of *Coptotermes* in Central America.

It should be stated at the outset that there are relatively few records of the establishment of termites in new countries, followed by great damage there. In this respect the termites are exceptional among insect pests. In the United States, for example, where introduced foreign pests are probably responsible for more than half of the insect damage suffered by crops, all of the most destructive termites are native species. Emerson (1936) has recently drawn attention to the difficulty which introduced termites appear to encounter in spreading from buildings to invade natural habitats. Nevertheless, instances of great damage by introduced termites are by no means unknown. In Hawaii the only destructive subterranean termite is *Coptotermes formosanus* Shiraki, introduced over 25 years ago from the Orient, and since then many foreign termites have been intercepted by plant quarantine inspectors at Honolulu. In St. Helena great damage is said to have followed the introduction of *Heterotermes* in 1840. *Coptotermes* in Barbados may be an introduced termite.

The termites most readily transported overseas are the dry-wood forms, because entire colonies can thrive in small quantities of wood, such as articles of furniture. The commonest dry-wood species in the West Indies, *Cryptotermes brevis*, is probably already present in all the inhabited islands. Few, if any, of the other Neotropical dry-wood species would appear to be a very serious menace to any island, though the introduction of any foreign termite should of course be regarded as highly undesirable. Subterranean termites, such as *Coptotermes*, are less easily transported, since they require access to water and have underground nests. The greatest danger lies in wood which has been in contact with the ground for some time before shipment, and into which winged reproductive forms may have ascended. These might survive a short ocean voyage, especially if the wood were wet by rain or spray or otherwise in contact with water, and a few of them, flying ashore, might establish themselves there. Subterranean termites have frequently been transported overseas in soil, but fortunately the importation of soil into most of the West Indian islands is already prohibited as a measure of plant protection. Fortunately, also, the presence of subterranean termites in transported wood can usually be detected fairly easily by inspection of the surface. The entry of termites from the soil is usually conspicuous because of injury to the wood or because of the covered passages of earthy or cement-like material, more or less tubular in form, which the workers build to avoid exposure. Wood that appears clean and sound can usually be regarded as free from subterranean termites.

After a careful consideration of the possibilities of new introductions of destructive termites into Lesser Antillean islands, and of the desirability of avoiding unnecessary restrictions on commerce, it seems advisable to suggest the following precautionary measures:—

(1) The importation from certain countries into the Lesser Antilles of lumber or other wood likely to have been in contact with soil or stored within reach of subterranean termites, should be subject

to inspection. This should apply especially to shipments into the northern islands from South and Central America, Trinidad, Tobago and Grenada to prevent especially the introduction of *Coptotermes testaceus*, and to shipments from Barbados into any other island because of the occurrence in Barbados of a species of *Coptotermes* as yet unknown elsewhere in the West Indies.

(2) Imported wood found to harbour termites should be held and the insects destroyed as soon as possible. When practicable, destruction should be by burning infested wood. For articles of value, such as furniture, general recommendations can scarcely be attempted here. Prolonged fumigation is effective and subterranean termites can be killed by allowing infested wood to dry, provided of course, that the termites have no access to water and are prevented from escaping outdoors by crawling or by flight.

(3) If any infestation of termites is found in imported wood, other wood in the same shipment should, of course, be subject to especially careful inspection.

The application of the above precautions would probably involve very little labour and expense. Most lumber imported into the Lesser Antilles comes from beyond the tropics, in clean condition, and the inspection of objects liable to infestation by the most dangerous foreign termites could probably be made with an insignificant addition to the duties of customs and plant protection inspectors.

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THE MANURING OF YOUNG RUBBER TREES.

THE manuring experiment on Block 6 at the Rubber Research Institute's Experiment Station was commenced in 1928. It was designed to compare the effects of an organic manure (cattle-dung) with various inorganic fertilizers, supplying nitrogen only, nitrogen and phosphate, phosphate and potash, and a " complete " fertilizer supplying nitrogen, phosphate and potash. Applications of these fertilizers were made in graded dressings, five during the first three years of growth, and five during the next five years. In the earlier years, the trees receiving cattle manure grew slightly better than the rest, but after the fifth year those receiving the complete (N.P.K.) inorganic manure caught up those receiving cattle manure, though the rest remained slightly behind. The trees came into tapping at the beginning of 1935; the yield results for the first two years of tapping are given.

It is notable that, although the cattle-manure treatment shared the lead with the complete (N.P.K.) inorganic manure, so far as growth (girth) measurements were concerned, and was the first to take that lead, the yield of rubber from the cattle-dung-treated trees was no better than that from the other trees which it had surpassed in growth. The only treatment to give a significant increase in yield was the " complete " (N.P.K.) manure.

The soil in the lowland areas of the Experiment Station, where this experiment is situated, is of a poor sandy type, and it is noteworthy that potash appears to be an important factor in the superior effect obtained thereon with the complete inorganic manure. Whilst it is now becoming increasingly evident that phosphatic manuring, whether as an adjunct to nitrogen or not, is a common requirement of many Malayan rubber soils, the need for potash, though probably less widespread, is probably also less uncommon than has hitherto been supposed.

Owing to differences in phosphate and potash content, as between the cattle-dung and the " complete " inorganic manure treatment, this experiment affords no conclusive evidence as to the relative merits of organic and inorganic nitrogenous manures.—(*Journ. Rubber Res. Inst. Malaya*, Vol. VIII, No. 1, pp. 3-4.)

THE AVOCADO (*PERSEA AMERICANA*, MILL.) IN THE WEST INDIES.*

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Introduction.

Relative to the extensive industry which has been developed in California, and to a lesser extent in Florida, the avocado in the West Indies, though widely grown for local consumption, still occupies a minor place, not only as a potential export commodity, but also as a fruit which might find a considerably extended use in the native dietary. Whether avocado cultivation is considered in terms of an export industry or from the standpoint of improving local supplies, the basic factor requiring attention is the same, namely, the selection of types possessing (i) good horticultural qualities in respect of productiveness, resistance to disease, &c. (ii) desirable commercial qualities including palatability, oil-content, size, appearance, ratio of stone to pulp, &c., (iii) an extended cropping period, and (iv) good keeping quality in cold storage. A brief consideration of some of the more important aspects will be attempted in this paper.

Horticultural Races and Selection of Useful Types.

Botanically, several distinct species have contributed to the genetic constitution of the many named varieties of avocado: horticulturally, it has been found convenient to refer cultivated varieties to three races, namely the Mexican, the Guatemalan and the West Indian (Popenoe, 1920). Of these, the Mexican is a mountain race, possessing among other distinctive characteristics, a considerable measure of resistance to low temperatures under orchard conditions; the Guatemalan race is regarded as a product of tropical highland regions (Central America), yielding fruit during winter and spring; the West Indian race (derived from the same species as the Guatemalan race, *i.e. P. americana*) is thought to have been developed in the humid tropical lowlands of Central America, and fruits during the summer and autumn months. Many intermediate environmental types and numerous hybrid seedling types which escape exact classification are also known.

It is now generally accepted that the avocado is not indigenous in the West Indies: it was probably introduced at a very early date, however, and for all practical purposes has been thoroughly naturalised for centuries. At the present time, West Indian avocados comprise a large collection of seedling types: these show a striking range in variation in respect of shape, size, colour, skin thickness and texture, flesh colour, oil content and palatability, size and shape of stone and the nature of its insertion, *i.e.* loose or adherent to the flesh. Of these "varieties" many are of poor quality. A considerable number might be described as intermediate in quality, while a comparatively small number might be considered good as judged by general commercial criteria.

This diversified collection of seedling types represents, as a first consideration, the raw materials on which an improved avocado industry, local or export, might be based. It was not until 1919, however, that the question of fixing useful selected types by vegetative propagation was given serious attention. The following quotation (Freeman, 1919) adequately summarises the situation as it appeared at that time: the avocado "has probably been cultivated in these islands for the last two hundred years or so, and until quite recent times has been propagated exclusively by seed. The result is that we have enormous numbers of trees here (in Trinidad), in Barbados, Grenada, St. Vincent, &c., of very variable characteristics; some very good, many of medium quality and a large number of a poor type. It is reasonable to suppose that the tendency has been to take care of the better kinds, and when trees had to be cut out, to get rid of those which were inferior. In other words we have been practising for a couple of centuries the preliminary work of seed selection, raising large numbers of seedlings, but without proceeding to the next stage of fixing the good types which have arisen."

In Trinidad, during the last twenty years, some attention has, in fact, been given to the selection of good types. These have been named or numbered and propagated, though to a small extent only, by budding and grafting. In this direction there is still, undoubtedly, ample scope for further work. With the initiation of storage investigations a new phase in the critical selection of varieties made its appearance. It was observed that, even at relatively low temperatures, maturation processes slowly continued, so that in varieties not sufficiently cold resistant, abnormal biochemical changes, described as chilling, were induced, the pulp typically developing a dark coloration. Accordingly, in working towards an export industry, it became necessary to select from possible commercial varieties those which were not subject to chilling injury at a temperature of 45°F., the most suitable temperature for overseas transport (Wardlaw and Leonard, 1935). In the course of an extended programme of experimental work it has become evident that among West Indian types only a comparatively small number combine the requisite commercial qualities with adequate cold resistance and keeping quality in storage. The practical problem is therefore essentially one of further selection, based on a knowledge of the behaviour of fruit in cold storage.

Extension of Cropping Period.

Whether fruit is grown for local consumption or export, the desirability of extending the cropping period is apparent. The problem

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is one which has called for consideration in all the more important avocado-growing countries. In Florida and in the Caribbean region, trees of the West Indian race typically fruit during the summer and autumn months. Among varieties considered to belong to the West Indian race, some, such as the Trapp, are known to have an extended fruiting season; in Florida late Trapps may hang on until February or March (Popenoe, 1920). Such late-bearing varieties appear to be very rare in the West Indian race, but, by contrast, varieties derived from the Guatemalan race are known which fulfil this requirement. So far, little has been done towards introducing such useful plants into the British West Indies. The question as to the adaptability of plants of the Guatemalan highland race to the range of environments afforded by the many West Indian islands is one which will call for a considerable programme of work. It also remains to be seen whether the seasonal fruiting characteristics of the Guatemalan race will remain unchanged. According to Popenoe "The Guatemalan kinds which have already fruited at Miami and elsewhere have served to indicate that the season during which this race will ripen, is, roughly speaking, November to May." It therefore seems not impossible that Guatemalan races, originally selected to suit Florida conditions might be introduced into West Indian islands with some measure of success. The introduction of propagating materials will call for careful consideration of a number of points. Given adequate quarantine facilities, bud-wood could be transported by air from approved nurseries and applied to established seedling plants. The bud-wood should be selected from hybrids (Guatemalan by West Indian and possibly Guatemalan by Mexican) or varieties (i) whose general physiological nature is sufficiently well known so that environmental suitability will, as far as possible, be assured, and (ii) whose fruit is known to possess the requisite commercial attributes combined with good keeping quality in cold storage.

Improved Oil Content.

By comparison with California and Florida avocados, the oil content (for which this fruit is notable) of West Indian varieties is disappointingly low. The question may therefore be asked : will an improvement in oil content be effected by introducing from California or Florida varieties specially selected for their high oil content? From the information available, the answer would appear to be that, if grown under West Indian condition, as for example, in Trinidad, the improvement in oil-content is likely to fall considerably below expectations. Reasons for this view are supported by the work of Stahl (1933). Stahl has indicated that under Florida conditions there is no absolute correlation between fat content and horticultural race : in general, West Indian varieties possess the lowest fat content, Guatemalan varieties occupy an intermediate position, while Mexican varieties yield the highest content. Exceptions, however, occur in all three races. Further, the same varieties grown in California, Florida and the West Indies have quite different fat contents, those grown under West Indian conditions producing least. Thus, of Trinidad fruits which have been analysed, the richest contained a proportion of fat below the minimum for California varieties. Stahl's data afford an acceptable elucidation of the problem under consideration. Fat values may be expressed either as a percentage of the original fresh (wet) weight or of the dry (water-free) weight of the pulp. When the same variety of avocado was grown under dry and wet conditions in Florida it was observed that fruits from the former usually showed a considerably higher (wet-basis) fat content. Dry basis determinations, however, were approximately identical. A knowledge of this relationship would therefore suggest that where avocados are grown in the West Indies under humid conditions, a high fat content cannot be expected. In so far as a large proportion of fat is not necessarily an indication of good quality nor of palatability, this need not be considered a major disadvantage except where oil production, as a by-product, is commercially feasible.

Summary.

Cultivated avocados are generally referred to three horticultural races, the Mexican, the Guatemalan and the West Indian, useful types being fixed and propagated by budding and grafting. Seedling avocados of the third group as grown under West Indian conditions, are characterised by a low fat content, great variation in all fruiting characters, and by their comparative intolerance of cold storage conditions, *i.e.* most varieties show chilling injury when held at temperatures below 50°F. (10°C.). To improve this crop, therefore, careful selection is necessary, due consideration being given to horticultural, commercial and storage factors.

Whether fruit is intended for local consumption or export it is also desirable that the cropping season should be extended. It is unlikely that this can be achieved by using plants of the West Indian race, as almost exclusively, these produce fruit during the summer and autumn months only: by introducing propagating materials of the Guatemalan race, however, the required extension might be obtained. Although the general standard of productiveness and quality could be raised by introducing and establishing improved types of avocado, it seems unlikely that any marked improvement in the fat content of fruits will be effected, this character being largely determined by environmental factors.

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FURTHER STUDIES IN TROPICAL LAND TENURE.

By H. M. Leake.

(*Continued from Tropical Agriculture*, Vol. XV, No. 9, p. 198.)

III.—EAST AFRICA.

Uganda.

The origin of the system under which large areas are held by individual chiefs, has been described in the previous series. It is a system which was recognized by the Uganda Agreement of 1899. The actual land settlement under that agreement with demarcation of the various areas was far from simple and was still incomplete in 1930 when 85 sq. miles of the Busoga District were set apart*. But the system, as the same Report notes, was foreign to the existing native ideas, proving unsatisfactory and degenerating into a system of rack renting. The two Buganda Laws, the Busulu and Enjuvo Law of 1927 and the Land Tax Law of 1928, were passed to limit the powers of exaction with the result that transfers of land are actively taking place and there is now a steady evolution towards a peasantry occupying their own holdings. Though the overall population is not great, some 44 per sq. mile, Uganda has never offered the same attraction for settlement by Europeans as its neighbour, Kenya; the wooded nature of the country which rendered it unsuited for ranching, and its relative inaccessibility at the time of the main influx have prevented this, and the total European population is now only some 2,000 persons as compared with some 18,000 in Kenya. There is, however, a growing Indian population which is not confined to a trading community and such European estates as come into the market are passing into the hands of Indians who have, further, started a sugar factory and distillery.

The dominant trend of tenure is, thus, in the direction of the establishment of a body of independent peasants paying a land tax but otherwise fully secured in the possession of their land. There arises, consequently, that inevitable question of how the produce from such an unorganized body of small producers can be aggregated to yield a graded product acceptable on the world's market. The primary export product of Uganda is cotton, a product particularly difficult to organise because, being an annual, raised from seed and one in which cross-fertilization readily takes place, full precautions have to be taken to guard the seed supply if purity of the product is to be maintained. Further, it is a plant peculiarly liable to be attacked by pests and diseases, the main protection against which is the destruction of all plant residues after harvest and of all seed not required for sowing or for export. Lastly, the seed-cotton as harvested in the field has to be subjected to a factory process of ginning to separate the seed from the lint which is baled for export. The main lines of this control were laid down in the Cotton Ordinance (11 of 1926), a long and comprehensive Ordinance controlling the production of cotton in all its stages, the administration of which is entrusted to the Director of Agriculture. The essential features of that Ordinance have been already described. This Ordinance has been reinforced by the Cotton Zone Ordinance (16 of 1933) which empowers the Governor to declare raw cotton zones out of or into which the movement of raw cotton is prohibited and, since this limitation would serve as a check on the freedom of marketing, he is also empowered to fix minimum prices within such zones. As the number of rules and regulations issued yearly under these Ordinances indicate, they have by no means been a dead letter and they form a severe, if necessary check on individual freedom and initiative.

Control of a more general nature not limited to cotton, has been introduced in the Diseases of Plants Protection Ordinance (13 of 1932). This established a Central Plant Pest Board composed of three officials, the Director of Agriculture, the Mycologist and the Entomologist, six nominees of the Governor and four unofficial members, two nominated by the Uganda Planters' Association and one each by the Toro Planters' Association and the Uganda Cotton Association. The function of the Board is advisory in connection with the rules laid down under the Ordinance which follow the usual lines.

Control of the marketing organization was introduced in 1933 under the Native Produce Marketing Ordinance (22 of 1933) and its amending Ordinance (15 of 1934). This follows in all essentials the corresponding Kenya Ordinance. Under it, rules have been formulated for coffee (L.N. 136 and 148 of 1934), ground nuts (L.N. 137 and 148 of 1934), sesame (L.N. 135, 148 and 222 of 1934) and leaf tobacco (116 of 1935). Coffee is further controlled under the Coffee Grading Ordinance (26 of 1930) requiring that the coffee shall be graded, marked and certified by a grader appointed by the Director of Agriculture. Under an Amending Ordinance (18 of 1932) coffee grown on, and directly exported from, an estate is not subject to this Ordinance.

In 1936 was passed the Tea Ordinance (4 of 1936) which, again, follows the lines of the Kenya Ordinance, licensing the culture of tea and

* Uganda, Colonial Repts. Annual, No. 1556 (1931).

limiting the total acreage. Thus, in the endeavour to widen the base of Uganda's export trade, a gradual extension of official control has taken place.

Tanganyika.

The Mandated Territory of Tanganyika is at once the largest, most sparsely populated and youngest of the East African group of Colonies. The density of its population is approximately 13 per sq. mile, a figure slightly less than that of Kenya with which, however, it cannot be properly compared since, in the latter, vast areas of practically uninhabited country exist to the north-east while, in the former, the population is relatively evenly distributed. There is this further difference that tribal organization in Tanganyika is not highly developed and there are no influential tribes of the importance of the Masai and the Kikuyu. Its accessibility from the coast has rendered it attractive to settlement by Europeans, but the date at which it came under the British sphere of influence postdated the period of intensive settlement and the white population is under 9,000.

Though the sparseness of the population renders the land available for settlement abundant, its wide distribution prevents any clear demarcation of a defined European area as in the Highlands of Kenya, and the regulations relative to the acquisition of land by Europeans, which are contained in the Land Ordinance (3 of 1923), merely declare all lands of the Territory to be public lands and, subject to any existing rights, available for disposal by the grant of right of occupancy. A further limitation is the denial of the right of transfer from native to non-native, a limitation laid down in the Property and Conveyancing Ordinance (2 of 1923).

The Territory has not yet passed that stage at which that primary function of Government, the assuring of the food supply of the peoples, ceases to be an active concern. Cases of dearth still occur locally as in 1930 in the Bukoba Province and over an area extending into the Belgian Congo. This primary function is implemented by the Native Foodstuffs Ordinance (17 of 1924) which authorizes administrative officers, with the consent of the Governor, to prohibit or restrict the removal of such produce from, or its movement in, a district and also to prescribe maximum prices. As long as these conditions exist, the question of production for export must play a secondary rôle.

The most important export crop of the Territory is sisal; it is raised on alienated estates by a labour force employed under the terms of the Master and Native Servants Ordinance (32 of 1923) and its amending Ordinances (11 of 1926 and 9 of 1927). The units are here sufficiently large to control their own marketing organization without official regulation, though sisal was declared to be produce under the terms of the Produce Export Ordinance referred to below (G.N. 184 of 1930), and rules laid down enforcing the special branding of sisal which had been prepared with the use of salt water (G.N. 185 of 1930). The only direct legislative measure, concerned with sisal is the Sisal (Tax) Ordinance (19 of 1933), one of a series of Ordinances designed to create a fund to be employed for the benefit of the industry generally by the imposition of a cess on exports. Tea is also an estate crop on a small scale and is regulated by the Tea Ordinance (14 of 1934) which makes the planting of this crop a subject for licensing by the Director of Agriculture and limits the area to 2,900 acres.

The main native products for export are cotton, coffee and ground nuts while hides are also exported in considerable quantities. Cotton is regulated by the Cotton Ordinance (13 of 1920) which follows the lines of those already described for Kenya and Uganda. It is a relatively brief Ordinance under which, however, very detailed rules have been issued (G.N. 287 of 1922 and many later notifications) giving power, among other matters, to prohibit cultivation in prescribed areas and to fix minimum prices, the whole administration of the Ordinance being in the hands of the Director of Agriculture. A Cotton (Tax) Ordinance (12 of 1933) imposed a cess on exports similar to that described for sisal and for the same purpose.

The coffee industry is controlled by the Coffee Industry (Regulation and Improvement) Ordinance (23 of 1928) registering all plantations and nurseries, granting powers of inspection to the Director of Agriculture, laying down rules for marks and licensing dealers exclusive of those disposing by sale or export of their own produce. The Coffee Factories' Ordinance (27 of 1932) laid down rules for all factories and curing works other than those owned and used by growers and associations of growers exclusively for their own produce, and a Coffee (Tax) Ordinance (14 of 1933) imposed a cess on exports similar to, and for the same purpose as, those imposed on sisal and cotton.

Coffee is, however, controlled in a more general way under the Produce Export Ordinance (7 of 1929) which authorized the formulation of rules by the Director of Agriculture and the Director of the Veterinary Service for the inspection and branding of scheduled produce, definition of standards, methods of sampling and even, in cases, the temperature to be maintained in transport. It established a Board, appointed by the above two Directors, of which the decision was to be final. Coffee was brought within the sphere of this Ordinance by the Bukoba Coffee Rules (G. N. 69 of 1932). The necessity of this control lay in the fact that two classes of coffee are produced which, in as much as the distinction between them follows the method of cultivation, whether on plantations or peasant holdings, are defined as plantation or *arabica* and native or *robusta*.

On the cultural side rules have been formulated for coffee also under the Plant Pests and Diseases Ordinance (38 of 1921) and are detailed in Notice (G.N. 139 of 1928) and a measure of decentralization in the matter of cultivation is given by Notice (G.N. 38 of 1930) which entrusted the Native Authority of Bukoba with the issuing of orders regulating cultivation. The above Ordinance for the control of Pests and Diseases is a general measure of the usual type under which rules have been formulated for coconuts (G.N. 199 of 1922). It is supplemented by the Noxious Plants (Prohibition) Ordinance (8 of 1926) under which *Cannabis sativa* has been declared a specified plant.

In the matter of cattle, the Diseases of Animals Ordinance (5 of 1920) gives the necessary power of control, while the Native Livestock Ordinance (15 of 1928) gives the Governor in Council the power to limit the head of stock carried.

One form of decentralization of control has been mentioned above. A more usual method of attempting the organization of produce for export has been inaugurated by the Co-operative Societies Ordinance (7 of 1932) under which there has been established the Kilimanjaro Native Planters Association while, in the Lake District, tobacco is disposed of by the Ngomi Matungo Co-operative Union.

Nyasaland.

The Nyasaland Protectorate is, in many respects, similar to Tanganyika in that it has a relatively evenly distributed population and an absence of any highly developed tribal system. The density of the population, though greater, some 42 per square mile, is not such as to have compelled any advanced form of indigenous land tenure. But its inaccessibility prior to 1935, when the Zambezi bridge was opened and through communication established with Beira and the sea, has prevented any large influx of European settlers who number only some 1,800. This even distribution of the population has not favoured the demarcation of areas suitable for such settlement and the available area is scattered and small. The major problem connected with the land concerns the indrift of tribes not indigenous to the Protectorate*.

The Crown Lands Ordinance (15 of 1912), which has been already described, governed the disposal of Crown Lands, but has been repealed by the Crown Lands Ordinance (1 of 1931) which laid down new, but similar terms for the lease of Crown Lands and established a Lands Office.

A further marked feature of the native population is the extent to which it finds employment outside the Protectorate, a strong stimulant of detribalization or weakening of the tribal system. This movement, together with employment of native labour generally, is controlled by the Employment of Natives Ordinance (6 of 1909) with its frequent amendments. Individual sections of this Ordinance deal with employment within and without the Protectorate and lays down rules for the licensing of recruiting agents. Employment on estates within proclaimed areas is further controlled by the Natives on Private Estates Ordinance (15 of 1928) described in the earlier series. This Ordinance empowers the Governor to acquire up to one-tenth of the area of an estate for the purpose of native settlement with the offer of other Crown Land in exchange. The whole system tends to build up an intermingling of native and alien occupied areas without the demarcation of a specific European area such as exists in Kenya.

The drift towards seeking employment outside the Protectorate is not without its repercussion on the tribal system and can only be held within reasonable bounds by the development of such markets for native produce that home cultivation offers as attractive an alternative mode of life as emigration. Here, again, is raised the familiar problem of how is to be aggregated into a standard product the produce of large numbers of small and independent peasants. The solution, in the main, has been sought along the usual lines. A general control of production in the field is exercised officially under the Plant Pests and Diseases Ordinance (1 of 1924) which gives power to enforce the usual wide measures of control and it is supported by the Noxious Weeds Ordinance (17 of 1936). But numerous more specialized Ordinances dealing with individual crops and particularly with the marketing of the produce of these, have been passed. Before these are mentioned, however, reference may be made to the establishment in 1933 of a Board of Agriculture the function of which is defined as the study of the problem of native agriculture in its broadest sense. It has considered and made recommendations on such subjects as the possibility of growing alternative crops including citrus, and erosion with its attendant problems of overgrazing, the formation of village forest areas and the management of the steeper slopes. In 1935 was established a Native Welfare Committee with its object the increase of the material prosperity of the native. Under its purview come not only agricultural production but sanitation, health and similar subjects.

Nyasaland in the past has depended for its wealth largely on tobacco which, in 1927 constituted 73 per cent. of the total exports. Since then a broadening of its markets to include other produce has taken place. Sisal, tea and coffee are now raised on estates while native production accounts for cotton, chillies, maize, potatoes, rice, groundnuts and beeswax. Cotton has long formed a staple, if minor crop of the Protectorate and steps for the regulation of its cultivation

* Col. Reports Ann., 1658 (1932).

and marketing were first taken under the Cotton Ordinance (7 of 1910), replaced by the later Ordinance (8 of 1923) which has, in its turn, been replaced by the Cotton Ordinance (16 of 1934). This Ordinance establishes in detail equal to that of the parallel Ordinances of other East African Colonies, a control of seed, time of planting and eradication of the crop, locality in which cotton may be grown, marketing and ginneries. Under the Crown Lands Cotton (Tax) Ordinance (1 of 1935) a cess of 6d. per 100 lb. seed cotton produced by natives on Crown Land was imposed to build a fund to be used in the improvement of cotton.

In 1926 powers were taken under the Maize Export Ordinance (7 of 1926) to prescribe standards and to make rules for inspection and the mode of packing maize. Tea, the earliest record of the introduction of which is 1878,* has, in recent years, received attention on estates. Control was introduced by the Tea Ordinance (17 of 1934), an Ordinance parallel to those of Kenya and Tanganyika, limiting the area to 1,700 acres and giving the Director of Agriculture powers of inspection, while the Tea Cess Ordinance (17 of 1935) imposed a cess similar to, and for the same purpose as, that imposed for cotton.

But the major effort has been devoted to the improvement of the tobacco crop. By 1934 the need for some organization which would prove to buyers that standard grades could be produced from year to year, became apparent and the demand arose for an export pool.† The Tobacco Ordinance (5 of 1926) had established a Native Tobacco Board with registration of native growers, licensed purchasers and permitted contracts with natives for the cultivation of tobacco, but otherwise limited purchase to licensed premises while allowing sale and purchase of green and uncured tobacco to and by the owner of the land. This control, however, was inadequate to produce the necessary standardization and, in 1936, was passed the Flue Cured Tobacco Ordinance (10 of 1936). This Ordinance established a Control Board composed of one official, two growers nominated by the Native Tobacco Association and two buyers nominated by the Native Tobacco Exchange, as a corporate body financed by a cess raised under the Tobacco Cess Ordinance (6 of 1934). The Board, in addition to advising natives on production, undertakes the purchase of all native 'dark fired' tobacco at a fixed price, subsequently baling and auctioning it. More recently, the Southern Rhodesian system of marketing by public auction has been introduced for Nyasaland tobacco and the first auction floor was opened by the Governor at Limbe as late as April, 1938. The auctions will be continued at Lilongwe for the disposal of the native crop which averages 12 million lb. per annum. This centralization secures a turnover sufficiently great to attract representatives of the large tobacco manufacturing companies and will, it is hoped, lead, as in Southern Rhodesia, to the payment of better prices.

* Dept. Agric. Nyasaland, *Bull.* 13, 1934.

† Col. Repts., Ann., 1739 (1934).

Zanzibar.

Though of limited extent, the island of Zanzibar, with its associated island Pemba, has played a part in the history of the world which is altogether disproportionate to its size. Long before historical times it figured largely in the life of those now vanished civilizations which flourished in the middle East, in Arabia, Mesopotamia and Persia. Some of these civilizations, notably those of Saba and Oman, were sea powers and carried on a sturdy trade with Africa and even the Malayan regions. Then, as now, fleets passed with the seasonal trade winds, between Arabia and Africa and the main entrepôt for the trade in the products of Africa, notably slaves and ivory, was Zanzibar. Zanzibar became, in fact, a centre of a definite colonial enterprise. In the course of time, with the waning of these powers, settlement from Arabia was replaced by settlement from India and Persia.

Though known to the early European civilizations, the first European visitors were the Portuguese in 1498. The Portuguese, however, obtained no real hold and in 1698 were evicted by forces from Oman when the suzerainty of the Arab was re-established. From then till 1861 the relation of Zanzibar to Oman was that of a colony. Ahmed Said, a descendant of that amazing character, Ahmed bin Said, the saviour of Oman and founder of the Abusaid dynasty, took up his residence in Zanzibar and, in 1832, assumed the title of Sultan of Zanzibar while still ruling Oman. The Treaty with India in 1798 and the slave trade convention of 1822 are important historical facts of this period. On his death the disputed succession was referred to Lord Canning, Viceroy of India, and his decision led to a severance of the connection between Oman and Zanzibar and the establishment of the present line of Sultans.

The later history of Zanzibar is dominated by the scramble for Africa which characterized the last quarter of the 19th century. By mutual agreement between Great Britain, France and Germany, the territories of the Sultan were delimited in 1886 to include Zanzibar, Pemba and a strip of the mainland coast ten miles deep. In 1890 a protectorate was declared by Great Britain over Zanzibar and Germany received Heligoland in compensation. A British Resident was appointed to the Court of the Sultan and the mainland territories administered from Kenya.

This brief historical summary is given to explain how Zanzibar comes to be associated with the British Empire and why its population is among the most cosmopolitan in the world. Those who desire to study this historical aspect, must read

elsewhere.* The importance of Zanzibar for all time has been its trade; the population has centered on the port and there has been no pressure on the land. The agricultural population consists mainly of certain African tribes and the definition of 'native' from the agricultural point of view is a member of the Wahadima, Wapemba or any indigenous African tribe but not Swahili or immigrant from the Comoro Islands or Madagascar. The other dominating agricultural fact was the introduction of the clove. As the result of the Dutch policy of monopolizing the trade of the Moluccas, to which the clove is indigenous, attempts were made to establish clove culture in many tropical countries. Among these were the West Indies and Cayenne where the clove was introduced in the eighties of the 18th century. Its introduction into Zanzibar is stated to have taken place in 1790 but the evidence collected by Troup suggests its introduction by Arabs in 1818.† Its systematic planting followed the direct orders of the Sultan in 1880. Since that date Zanzibar has become the centre of the clove industry, producing over 80 per cent. of the world's supply, and cloves from the dominant produce of the islands accounting, in 1930, for £803,000 of the £1,121,000 exports of which the balance is mainly copra.

As the result of the absence of pressure on the land, the question of tenure has not been of sufficient importance to require complete clarification. Unoccupied land appears to have been taken up at will and brought under cultivation, thus giving rise to a claim. The nature of the tenure claimed differed, largely by district, according to the status of the occupant; the Arab appealing to Mohammedan law, the African to Kiambo law which recognized joint ownership by family groups. In 1915 a Land Settlement Decree (7 of 1915) was passed but never put into operation and, as the Pim Commission pointed out, the English attitude in all matters of law as well as towards land prevailed.‡ Thus, the Registration of Documents Decree (19 of 1919) was copied word for word from English precedent while the Limitations Decree (2 of 1917) and the Transfer of Property Decree (5 of 1917) both admitted an indefeasible title to real property. It was not till 1921 that a Public Lands Decree (32 of 1921) was passed to protect public land from unauthorized occupation; under it Government claimed as public lands all waste land, called *Wanda*, unoccupied land not forming part of a shamba to which good title could be shown and all land used or occupied by members of native communities either collectively or individually. Under it, too, transfers between natives were not required to be registered.

Meanwhile difficulties arose over defining boundaries to landed property through the absence of survey. In 1910 a Land Survey Decree (8 of 1910) was passed which authorized the Resident to institute a survey when it appeared to be expedient, but no action appears to have been taken under it. The question of survey is discussed both in the Pim and Strickland* Reports; but a survey is an expensive item and, beyond experiments to test the potentialities and usefulness of an aerial survey, no steps appear to have been taken though the Decree was amended in 1922, 1931 and 1934.

After the war, a further difficulty arose through what may be termed an Indian invasion through Indians taking up land mainly in satisfaction of debt. As pointed out by Strickland, the usual procedure here was that the Indian took possession of the land but left the former occupier in possession as tenant. To meet this situation were passed the Alienation of Land (Restriction and Evidence) Decrees (1 and 39 of 1934) which supplemented the Transfer of Property Decree (30 of 1921). These Decrees controlled the power to alienate land and arranged for such transfers when the land was held by Arabs or Africans. They also limit the duration of a mortgage to 20 years with possession or, without possession and after failure to redeem the mortgage to 20 years with possession from the date of such failure. Further, they forbid Arab or African to lease land for more than 20 years.

In the absence of any dominant land question, there has arisen a system of small peasant holders and, in the absence of any mineral resources, agricultural production for export becomes the major contribution to the wealth of the islands, the two important crops being cloves and copra. Of both these products the islands have no monopoly though, as stated, Zanzibar, with Pemba, produces over 80 per cent. of the world's supply of cloves. The authorities have, consequently, been mainly concerned with the question of quality in these products, always a difficult problem under such a system of production. As early as 1915 an Agricultural Produce Decree (6 of 1915) was passed under which dealers in cloves, copra and coffee were licensed, permits to remove produce were required and a register of all transactions ordered to be kept. Powers were also taken to extend its application to other produce. In 1922 was passed the Plantations Preservation Decree (18 of 1922 amended by 7 of 1923 and 23 of 1931) under which all clove

* F. B. Pearce, Zanzibar, the Island Metropolis of Eastern Africa; W. H. Ingrams, Zanzibar, its History and Peoples.

† R. S. Troup, Report on Clove Cultivation in Zanzibar, 1932.

‡ Commission appointed by the Secretary of State to report on the Financial Position and Policy of the Zanzibar Government in Relation to its Agricultural Resources, 1932.

* C. F. Strickland, Report on Co-operation and certain Aspects of the Economic Conditions of Agriculture in Zanzibar, 1932.

and coconut plantations were placed under the general supervision of the Director of Agriculture. The Decree lays down a standard of cultivation in much detail. Thus the occupier must burn or bury to a depth of three feet all dead or diseased trees, must prune off and burn diseased branches and must not leave heaps of decaying vegetable matter to lie. The Director, working through Inspectors, may order such work to be done and recover cost by suit. This somewhat drastic attempt to control by official action private production was accompanied by the Agricultural Returns Decree (4 of 1922) arranging for the returns of agricultural production. Under it the Director of Agriculture was authorised to collect such information as may be required.

In 1927 the Clove Growers' Association was formed on the initiative of the Agricultural Department as an unregistered body and Government loans which were advanced for the purpose of planting cloves, were made conditional on the recipient becoming a member of the Association. Advances were made through the Association for harvesting and against security of deposited cloves. They were given free of interest together with six months' free storage. An export standard of 16 per cent. moisture and 5 per cent. extraneous matter was laid down. It was not till 1934, however, that the Association received a formal status under the Clove Growers' Association Decree (2 of 1934). It required, in fact, the slump in the world's prices, which hit Zanzibar no less than other countries, to direct serious attention to the conditions of marketing the produce of the peasantry of the islands. The Transfer of Agricultural Produce Decree (4 of 1931) had regulated the advances and loans made by the purchaser against produce while the Trades Licensing Decree (5 of 1933 amended by 32 of 1933 and 37 of 1934) made licensing compulsory for any trade other than that of an agriculturist selling or otherwise disposing of the produce of his own estate or holding. But 1934 is distinguished for a number of Decrees in addition to the Clove Growers' Association Decree above mentioned. The Agricultural Produce Export Decree (3 of 1934) limited export to such produce as had been officially inspected, graded and branded; laid down specifications for the various grades, for methods of sampling and for fixing times of inspection, and controlled the boats used for transfer of the produce to prevent damage during transfer to the ship. Produce for the purpose of the decree is defined as cloves and copra. Appeals are laid to the Director of Agriculture whose decision is final. The Clove Exportation Decree (4 of 1934) made licensing obligatory for export while the Adulteration of Produce Decree (19 of 1934) defined standards for cloves and copra, laid down the powers of inspectors and actually sanctioned payment to informers.

Under the Agricultural Produce Export Decree of 1934 efforts have been made to improve the quality of copra as well as of cloves. Inspectors were appointed to impart instruction and assistance in the drying of copra and, by 1936, over 200 drying kilns were in operation in Zanzibar and 80 in Pemba. It is recorded that, owing to the better quality of the copra due to the use of kilns, export merchants were able to segregate better qualities and had commenced to export to northern European countries and to India, markets which were previously closed on account of quality.*

But if this official action resulted in a definite improvement in quality, there is another aspect of the matter. On February 6th, 1936, riots took place in Zanzibar which ended in bloodshed and, as the report of the investigating Commission showed,† the riots were, in large measure, an expression of dissatisfaction among the copra dealers with the manner of the control exercised. Official action had, in fact, outrun the understanding of those in whose interests it was taken.

(*To be continued.*)

* *Zanzibar Blue Book*, 1936.

† Report of the Comm. of Enquiry on the Riots in Zanzibar, 1936.

STATUS OF THE AMAZON FLY IN BRITISH GUIANA, 1937.*

It is necessary to follow for a number of years the status of an introduced parasite in its new environment before an opinion can be formed as to the rôle the insect is playing in combatting the pest for which it was secured.

The first consignment of the Amazon fly, *Metagonistylum minense* Towns., arrived in British Guiana from Brazil on 30th August, 1933, and between that date and 31st October, 1933, a total of six consignments was received totalling 3,000 puparia, and from these 1,409 flies were secured. From these initial stocks some liberations were made directly into the sugar-cane fields, as well as material obtained to start extensive rearing operations. As the work progressed laboratory assistants were trained in the technique of rearing the insect and field laboratories set up in conjunction with the different estate authorities on ten sugar estates scattered over the sugar area of the coastlands. During the period these laboratories were in operation a total of over 379,000 flies was reared. About the end of 1935 work ceased and no further

* Adapted from a paper of the same title by L. D. Cleare in *Agric. Journ. of British Guiana*. Vol. IX, No. 1, pp. 12-24, 1938.

flies were supplied to the estates in most instances. From this time, therefore, the fly has been continuing on its own, under conditions that it must meet and survive if it is to exert any control on the sugar-cane moth-borer, *Diatraea saccharalis* F.

Examinations made on sugar estates at different times after the introduction of the Amazon fly showed long since that the insect had established itself not only in sugar-cane but also in rice, and, as regards the former crop at least, was parasitizing a fair proportion of the *D. saccharalis* in that host plant. A survey carried out about the middle of 1935 by Mr. F. A. Squire showed further that some two years after the introduction of the parasite and the colonization of the sugar estates the insect was still doing good work. The results of this survey were not published. About a year ago it was considered desirable to undertake another survey, and in January 1937, the work was commenced, continuing, as opportunity allowed, to January 1938. In the present survey it was not possible to carry out examinations of all the sugar estates in British Guiana owing to the pressure of other work and the limited staff of assistants, but a total of fifteen sugar estates was examined during the survey, extending from the extreme east of the Colony to the West Bank of the Demerara River. It is believed, however, that both the number of estates examined as well as the area over which they are extended are sufficient to allow the results to be considered as being representative of the general conditions over the sugar-growing area.

On the fifteen estates surveyed a total of 212 fields were examined, and in 155 fields (73.1 per cent.) the Amazon fly was found either parasitizing *D. saccharalis* or *D. canella* Hmpsn., or both, 144 fields showing a parasitism of *D. saccharalis* only, but no field was found in which only *D. canella* was parasitized. In these fields a total of 37,332 "deadhearts" were cut out, of which 20,998 (56.3 per cent.) were empty. Of the remainder, 14,274 (37.9 per cent.) contained living *Diatraea*, in the proportion of 6,271 (43.9 per cent.) *D. saccharalis* and 8,003 (56.1 per cent.) *D. canella*. As the result of this survey it has been found that not only is the Amazon fly present in the fields, but that it occurred in 73 per cent. of the fields examined. In such fields the fly was parasitizing an average of 16.0 per cent. of the *D. saccharalis* population and 0.32 per cent. of the *D. canella* population, and taken over all fields these figures were 13.7 per cent. and 0.23 per cent. respectively.

Records were kept during the survey as to the number of parasites per host. Of a total of 863 *D. saccharalis* records, it was found that 513 (59.4 per cent.) contained only a single parasite, 263 (30.5 per cent.) contained two parasites, 66 (7.6 per cent.) contained three parasites, 17 (1.9 per cent.) contained four parasites and only 4 (0.5 per cent.) contained five parasites per host. The puparia of the fly found in the field agreed very closely with these figures and were in the proportions of 59.4, 31.4, 7.5, 1.4 and 0.3 per cent. for one, two, three, four and five parasites per host respectively.

In January 1937, Mr. H. W. B. Moore recorded a hyperparasite of the Amazon fly, but this was not unexpected, for it had long been known that the native fly parasite of *Diatraea, Stomatodexia diadema* Wied., was attacked by the hyperparasite, *Signiphora dipterophaga* Girault. The possibility of this insect attacking the Amazon fly was well recognised at the time of the introduction of the fly. This was confirmed when a determination of the insect was made by Dr. C. Ferrière of the Imperial Institute of Entomology. On four of the fifteen estates examined hyper-parasites were found. Hyperparasitism of the Amazon fly puparia occurred in 27.1 per cent. of the fields on the estates on which it was found, and 9.6 per cent. of the puparia were attacked. In this connection it should be pointed out that the hyperparasitism, occurring as it does to puparia, takes place after the parasite has done its work and killed the host larva. The destruction of the host population to the extent of 16.0 per cent. has already taken place. Further, if the hyperparasitism is calculated on the whole Amazon fly population it is only 3.3 per cent.

That the Amazon fly is doing good work in the sugar area the figures given now leave no room for doubt. There can likewise be no doubt as to the value of the introduction, nor that the cost of the undertaking has been amply repaid. Beyond this we should not go at present. It is still too early to draw conclusions or make statements as to the future work and destiny of the parasite, and mere guesses, pious opinions, or statements based on scanty data, are of no value.

EFFECT OF ZINC ON GROWTH.

The changes in growth in citrus suffering from mottle leaf, which occurred after an application of a spray composed of zinc sulphate 10 lb., hydrated lime 5 lb., water 100 galls., are described by H. S. Reed and E. R. Parker in the *California Citrograph*.* The existing dwarfed and mottled leaves took on a natural green without increase in size. The subsequent leaves, however, produced in the first cycle of growth after spraying were healthy and of a normal size. Improvement was also shown by the longer shoot growth, greater distance between leaves and the presence of blossom. Internally there was no significant difference between the thickness of phloem in twigs from sprayed or unsprayed trees, but the xylem cylinder was seen to be distinctly thicker in the sprayed trees, particularly when the older twigs were compared. An increased cambium activity would logically follow the great increase of chlorophyll-bearing area.

* Vol. XXII, 1937. pp. 411-12.

WEST INDIAN NOTES.

(Compiled by the Advisory Department, Imperial College of Tropical Agriculture.)

The Sugar Industry.

Owing to very unfavourable weather conditions in the majority of the Islands in the growing season of 1937, total sugar production in 1938 in the Eastern Group of the British West Indies did not reach the high level of production in 1937. Total production figures for the 1937 crop are given in the following table:—

Island.	*Tons of sugar.*
St. Vincent	1,600
St. Lucia	8,600
Antigua	22,225
St. Kitts	27,935
Barbados	111,415

The export quota allocated to Trinidad, Barbados, the Leeward Islands and the Windward Islands under the International Sugar Agreement for the year beginning September 1938 is as follows:—

	Tons.
Trinidad	132.200
Barbados	109,200
Leeward Islands	51,250
Windward Islands	10,050

Better growing conditions for the 1939 crop have so far been experienced this year than for the corresponding period last year.

A company has recently been formed in St. Vincent for the purpose of blending fancy molasses produced on the Island and effecting the better organization of its export. About 70 per cent. of the Island's production of syrup is exported by the company. Early reports state that the beneficial effect of blending on the uniformity of the product is very marked.

The experimental programmes conducted by the agricultural departments in co-operation with the respective Sugar Cane Investigation Committees in Antigua and St. Kitts and under the direction of Mr. P. E. Turner, Sugar Cane Agronomist, have continued to furnish valuable information. The progress already made is such that it may be reasonably assumed that with the practical application of the knowledge gained the average annual production of sugar will be maintained at a higher level in future and that in any season of favourable weather conditions larger crops will be produced than in the past.

Arrowroot in St. Vincent.

Total production for the crop year ending July, 1938, amounted to 39,442 barrels of arrowroot starch. This is a record production and the increase is mainly the result of improved cultural and factory practices.

The Cotton Industry.

Total production figures for those Islands which have already completed their crop in the present year and estimates of production in Montserrat and St. Kitts where the crop is not yet completed are given in the following table:—

Island.	*Year.*	*Production—lb. lint.*
Anguilla	1937–38	15,000
Antigua	1937–38	175,000
Barbados	1937–38	Nil.
Nevis	1937–38	375,000
St. Vincent	1937–38	692,000
Virgin Islands	1937–38	5,800
Montserrat	1938	400,000
St. Kitts	1938	200,000

In Montserrat the planting season of 1938 began at the end of January and was completed on April 16th. Germination was excellent but the very dry condition which were experienced from February to May seriously affected the development of the crop. With the onset of rains in June plants which had already formed and matured a small crop of bolls burst into renewed or secondary growth. A moderate late crop is expected from the secondary growth. Owing to the long and severe dry season in St. Kitts the bulk of the crop will also be late this year.

Sales of Sea Island cotton have been very restricted in 1938 and the industry in the West Indies is threatened with serious competition from American Grown Sea Island cotton.

Tomatoes.

Exports of tomatoes from Montserrat in 1938, amounted to 36,611 crates (20 lb.), 5,000 crates less than in 1937. Unfavourable weather conditions are claimed to have caused a decline in production. Growers however gained much useful experience in selecting fruit of the correct stage of maturity for export to the Canadian market.

Increased interest is being taken in the production of tomatoes in Antigua and exports during the 1938 season amounted to 4,881 crates.

Bananas.

The quantity of bananas sold from the Eastern Group of the British West Indies to the Canadian Banana Company for the first eight months of 1938 is set forth in the following table in comparison with those for the same period in 1937.

Bananas Exported to the Canadian Banana Company for the period January to August 1937 and 1938.

	Trinidad.		Grenada.		St. Vincent.		St. Lucia.		Dominica.		Total.	
	1937.	1938.	1937.	1938.	1937.	1938.	1937.	1938.	1937.	1938.	1937.	1938.
Nines ...	48,337	24,167	40,930	31,612	9,252	8,006	19,890	23,575	21,200	13,040	139,609	100,400
Eights ...	38,150	20,736	31,164	17,996	15,040	11,980	23,044	23,772	24,374	12,276	131,772	86,760
Sevens ...	36,890	8,942	32,270	15,542	17,752	11,736	19,972	15,060	21,324	10,140	128,208	61,420
Sixes ...	—	—	1,976	—	1,316	—	648	—	88	—	4,028	—
Total Stems	123,377	53,845	106,340	65,150	43,360	31,722	63,554	62,407	66,986	35,456	403,617	248,580
Equivalent Counts	95,395	44,190	80,932	52,880	29,737	22,859	47,321	48,934	49,939	27,317	303,324	196,180
Percentage Count	77 %	82 %	76 %	81 %	68 %	72 %	74 %	78 %	75 %	77 %	76 %	78 %

Stems purchased but not Shipped :—

	1937.	1938.
Trinidad ...	—	19,776
Grenada ...	—	10,870
St Vincent ...	—	13,224
St Lucia ...	—	27,225
Dominica ...	—	31,473
Total ...	16,928	102,568

Brevities.

At the end of June two ¾-bred Holstein bulls were shipped to Nevis from the Government Farm, Trinidad.

* * *

Mr. P. E. Turner, Sugar Cane Adviser to the Commissioner of Agriculture, visited Antigua from 25th June to 11th July, and St. Kitts from 12th to 22nd July.

* * *

Mr. C. K. Robinson, Agricultural Assistant, St. Vincent, has been appointed Agricultural Superintendent in that Colony with effect from 20th January, 1938.

* * *

Professor Hardy, Professor of Chemistry and Soil Science, and Mr. C. C. Skeete, Acting Commissioner of Agriculture, visited St. Vincent from 8th to 14th June.

* * *

Mr. J. M. Cave, Agricultural Assistant, St. Kitts-Nevis, has been transferred to British Honduras to succeed Mr. H. L. Manning. Mr. Cave left Nevis on 2nd September.

* * *

In July four large black boars and one Alpine buckling were shipped to Antigua. These animals complete the programme under the 10-year Development Scheme for the improvement of livestock in Antigua and Barbuda.

* * *

Mr. H. L. Manning, formerly Agricultural Officer in British Honduras, has been appointed Cotton Research Officer, St. Vincent, to succeed Mr. S. H. Evelyn, who has been transferred to the Sudan. Mr. Manning arrived in St. Vincent on 9th August.

* * *

Mr. E. A. Evans has been appointed as Soil Analyst to the Sugar Cane Investigation Committee of St. Kitts. Mr. Evans arrived in Trinidad on 26th August to undertake a special short course of training under the direction of Mr. P. E. Turner, Sugar Cane Adviser to the Commissioner of Agriculture.

* * *

Mr. F. A. Squire, Entomologist, Cotton Pests Investigation, left St. Vincent on 25th May for the Leeward Islands. During June and July he visited Antigua, Montserrat and the Virgin Islands and returned to St. Vincent at the end of July. At the end of August he proceeded to Barbados for two weeks and he spent the latter part of September in Montserrat.

* * *

Mr. E. T. Ward, Agricultural Superintendent, St. Lucia, arrived in St. Lucia early in September and assumed the duties of his appointment. Before proceeding to St. Lucia, Mr. Ward spent a week in Trinidad, where, through the courtesy of the Department of Agriculture and the Imperial College of Tropical Agriculture, he was able to observe agricultural methods adopted with a variety of crops in that Colony.

REVIEWS.

THE SOILS OF PALESTINE.

By A. Reifenberg. Translated by C. L. Whittles, *Thomas Murby & Co.*, London, 1938, pp. 131, with 9 plates, price 14s.

This book describes soil formation and land utilization within a typical Mediterranean region where the parent rock material is mainly limestone. It is stated in the Preface that the lands of Palestine have steadily deteriorated for 1,500 years, that terrace cultivation has been abandoned, irrigation works allowed to go into disuse, trees destroyed, and the soil left exposed to the forces of erosion. If the ancient fertility of the country is to be economically restored by the new Jewish immigrants, it is urged that the fundamental properties of the soil must first be appreciated.

The subject matter starts with a short account of the geology, topography and climate of Palestine, followed by a detailed consideration of the weathering processes which have brought about the differential evolution of the soils of regions classed as arid, semi-arid, semi-humid and humid. Next, soil formation under Mediterranean conditions is compared with that under other climates, after which the selection and manuring of soils for citrus cultivation, and the problems of irrigation, are discussed. Finally, Zionist colonisation is described from the time of the formation of the Petah-Tiqva orange-growing colony in 1878 to the present day.

Palestine lies in the subtropical zone; its climate shows a well-marked winter rainy season, followed by five summer months of almost complete drought. The annual rainfall varies from 35 inches around Jerusalem in the centre of the country and around Nazareth in the north, to less than seven inches in the Jordan Valley, lying along the eastern border. The soils include (1) yellow sandy desert soil, yellow loess-dust soil, saline soil and limestone semi-desert soil developed in the southern part of Palestine and in the Jordan Valley; (2) brown, semi-arid steppe soil of high fertility, occurring in the coastal plain around Gaza; (3) red sandy soil with or without calcareous or ferruginous concretions ("kurkar"; "nazzaz"), occupying the northern part of the coastal plain, from Rehoboth to Haifa, and formed under a semi-humid climate; (4) "terra rossa" limestone soil, which is a humid climatic type, covering the greater part of central Palestine west of the Jordan Valley, and (5) red earth derived from basalt under humid conditions, occurring in upper Galilee and the highlands of Judea.

The predominant colour of the Palestinian soils is bright red and their composition is siliceous; the author discusses the physico-chemical processes whereby these two features are so constantly associated in the development of terra rossa and red earth soils, and presents in detail his own well-known explanation of red soil formation, involving a theory of protection of colloidal suspension of iron oxide by colloidal silica against precipitation by lime. During dry seasons, the stable iron-rich ground-water rises into the upper alkali-salt zone, where iron oxide is precipitated because of the high degree of alkalinity and the high concentration of salts, forming red pellicles around the residual soil particles.

The main centre of citrus culture in Palestine is the Coastal or Maritime Plain, where the red sandy soils are irrigated, though not without risk of salt injury.

F. H.

* * *

CANE SUGAR PRODUCTION, 1912-37.

By H. C. Prinsen Geerligs and R. J. Prinsen Geerligs, *Norman Rodger*, London, 1938, pp. 164, price 10s.

The book may be described as a Supplement to the World's Cane Sugar Industry (1912), and is divided into two parts. The economic history of sugar for the years 1912-38 is dealt with in Part I, which opens with a chapter on the origin of sugar-cane, and the development of the many new varieties produced by sexual propagation. This is followed by a description of the policies adopted by the Allies during and after the Great War to keep themselves supplied with sugar, the final end of the Brussels Convention, and the subsequent British Colonial and Dominion sugar policy and its consequences. Next is given a description of the great slump in world sugar prices which occurred in the "twenties" and the attempts made to overcome it. These included Tarafa's Missions, the Chadbourne Scheme, the Jones-Costigan Act, League of Nations assistance up to and including the International Sugar Agreement of 1937, and the five per cent. reduction in quotas made by the International Sugar Council in April 1938.

Cane sugar production in the different countries of the world is described in Part II. Interesting notes on the history and progress of the work are given, together with carefully prepared and comprehensive statistics of production, marketing, &c. Some idea of the completeness of the record is shown by the fact that in all about 60 countries are mentioned.

The book is excellent for reference purposes, and should form part of the library of any institution connected with the cane sugar industry. A few modestly-worded lines from the preface are quoted as follows:—

"We have carefully noted down all that has happened in the province of cane sugar production and distribution during the last quarter of a century and we present the out-come of our gleanings to the public".

R. D. E. Y.

EROSION AND SOIL CONSERVATION.

By G. V. Jacks and R. O. Whyte, *Bull. 25, Imperial Bureau of Pastures and Forage Crops*, and *Tech. Comm., No. 36, Imperial Bureau of Soil Science*, England, 1938, pp. 206, price 5*s*.

This bulletin is the joint work of the Deputy Directors of two of the Imperial Agricultural Bureaux, and has been compiled with the co-operation of official correspondents and others throughout the world. The aim has been to describe "the present position with regard to erosion in the most seriously affected countries, the causes that have brought erosion into being, and the measures that are being taken or are contemplated to eliminate the causes and mitigate their effects."

The arrangement of the subject matter is geographical. The greatest amount of space is devoted to the United States and Canada, namely 69 pages, concerning which most literature has been published. Erosion problems in Africa are discussed in 54 pages; India and Ceylon in 14 pages, and the Mediterranean countries in 14 pages, leaving only 48 pages for other continents or countries, including the West Indies, 8 pages. Evidently the available information is very variable in quantity; erosion in *tropical* regions is dealt with in 67 pages, of which 31 pages concern East Africa and 25 pages, India, Ceylon and the East Indies.

The bulletin does not attempt to give technical information on flood and erosion control, concerning which many textbooks are now available. Although the principles of soil conservation are well established, the methods of their application are constantly changing, in so far as the significance of erosion in sociology becomes increasingly recognised.

F. H.

* * *

LEGUMINOUS FORAGE PLANTS.

By D. H. Robinson, *Edward Arnold & Co.*, London, 1937, pp. 120, price 6*s*.

This book is essentially a description of the botanical characteristics of the leguminous forage crops cultivated in Great Britain at the present time. These all belong to the order Leguminosae, sub-order Papilionaceae. As the descriptions are written in simple non-technical language the book is an excellent key to enable either the student or the farmer to recognise any particular forage legume. The text is adequately illustrated with drawings taken from actual field specimens by the author himself. The author is also to be complimented in the arrangement of the subject matter. The first chapter outlines the general characters of the sub-order, and records all the important genera. The subsequent chapters open with a description of the genera discussed, after which a detailed account of the various species is given in which the leaf, the flowers, and the seed characters are all described and illustrated. This handbook undoubtedly forms a very useful reference for all those who are in any way interested either botanically or practically in the forage legumes of the British Isles.

D. D. P.

* * *

ANNUAL REPORT ON THE PROGRESS OF RUBBER TECHNOLOGY.

Vol. I, 1937. pp. 153. *Institute of the Rubber Industry*, 12, Whitehall, London, S.W.1. Price 10*s*. 6*d*. to non-members; 5*s*. to members.

This is the first of a series of reports which it is proposed to publish annually, giving an outline of the year's progress in scientific and technical discoveries in the rubber industry. The subject matter is arranged in a series of articles, each written by a recognised authority on a particular branch of the science and technology of rubber. There are 24 separate articles, ranging in length from 3 to 11 pages, and dealing with such matters as rubber planting, the properties and uses of latex, physical chemistry of raw and vulcanised rubber, synthetic rubber and compounding ingredients, as well as the manufacture of rubber articles, such as electric cables, tyres, belts, hose, floors, sponges, toys, surgical appliances and footwear. Indexes of authors' names and subjects occupy the last 16 pages. The printing is exceptionally clear, and each article has its own list of selected references. The publication should prove most useful to all who are interested in any way in the rubber industry and its related sciences.

F. H.

* * *

REPORT OF THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

Thirtieth Annual Report for the year 1936-37. *H.M.S.O.* London, pp. 136, price 2*s*.

The report gives an instructive account of the wide-spread work of the Imperial College of Science and Technology, London, S.W.7. During the year the total number of research workers alone numbered 311, and there has been a great increase in the volume of research work, which tends to increase from year to year. Publications of particular agricultural interest have been contributed, especially by the Departments of Botany, Zoology and Applied Entomology and Chemistry.

E. McC. C.

* * *

THE STUDY OF THE SOIL IN THE FIELD.

By G. R. Clarke, *Clarendon Press*, Oxford, 1938, 2nd Edit. pp. 192, price 6*s*.

The first edition of this useful book was reviewed in *Tropical Agriculture*, Vol. XIII, No. 12, p. 333. A second edition has now appeared, which shows little alteration but embodies a certain amount of entirely new material. The book should continue to be of value to soil scientists and others interested in soils in the field.

E. McC. C.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

A Conductivity Method for Moisture in Bagasse.—*G. Gundu Rao.*

When a sample of wet bagasse is digested in a salt solution, the concentration of the salt solution must diminish to an extent governed by the amount of moisture in the bagasse. Therefore, a measure of the dilution of the solution after the digestion will allow a determination of moisture per cent. in bagasse; as the extent of dilution is relatively small, it can be measured by the change in the electric conductivity of the solution. The necessary solution may be obtained by digesting the bagasse in a hot salt solution, and a portion of this same solution may be used for estimating sucrose per cent. in bagasse, an operation that is already a matter of routine. The suggested method is to digest a weighed sample of the bagasse for one hour in a Deerr digester with one litre of a normal sodium chloride solution, the conductivity of which has been previously determined. The conductivity measurements are made by the Leeds & Northrup bridge equipment.

The results are calculated by the formula :—

$$\text{Moisture \% bagasse} = \frac{100v_1}{m} \times \frac{(C_1 + C + C_2)}{C_2},$$

where v_1 is the initial volume of the salt solution m is the weight of the sample in grams, C_1 and C_2 the conductivities before and after the digestion, and C the specific conductivity of a plain water, extract of the bagasse. The value of C may be established once for all if the factory is operating under fairly normal conditions, or the correction may be expressed as a definite fraction of the "last expressed juice conductivity", the last expressed juice being sampled at the same time as the bagasse, and its conductivity determined. Results by this method are shown to agree very well with the results obtained by drying bagasse samples in an oven.—(*Facts About Sugar*, Vol. 33, No. 5, p. 35, 1938.)

* * *

Chemical Analyses as an Aid in the Control of Nitrogen Fertilization.—*J. H. Yuen and R. J. Borden.*

Rapid chemical methods of estimating nitrogen in soils were applied to a study of the availability of nitrogen in Hawaiian soils and the general relations of nitrogen to plant growth. The nitrate and the ammonia nitrogen were estimated separately, and their sum was regarded as the amount of nitrogen available to the plants at the moment of sampling.

It is first of all emphasized that the nitrogen content of a normal soil is subject to fluctuation from various causes, such as increase by nitrification or decrease by leaching, immobilization by micro-organisms, removal by growing plants, and possibly by chemical reduction, so that the analytical figure for nitrogen content of the soil is valid only for the moment at which the analysis has been made. However, the information thus secured is of distinct use in diagnosing the nitrogen of a soil on which cane or some other crop is about to be planted.

The rapid chemical tests are at least valid to the extent that they permit the establishment of more or less definite "fertility levels" for soil nitrogen, as low, doubtful, medium or high, thus :

Group.	*Per cent.*	*Pounds N per acre-foot of soil.*
Low ...	0.001	−25
Doubtful ...	0.001−0.002	25−50
Medium ...	0.002−0.004	50−100
High	+0.004	+100

In practice, the two levels "low" and "high" have the most significance. When the nitrogen level is low, the nitrogen found may be disregarded and the full amount of nitrogen required for a satisfactory crop is added as commercial fertilizer. In Hawaii it is considered that a satisfactory cane crop calls for the use of 150 to 250 lb. of nitrogen per acre. If the rapid chemical test places the soil in the "high" nitrogen group, then a safety factor of 50 per cent. should be applied to take care of possible sampling fluctuations of the soil nitrogen.

For example, assuming that the analysis shows 188 lb. of nitrogen per acre-foot, and assuming that 200 lb. per acre-foot is the minimum requirement for a good crop, then 200 minus 94, or 106 lb. is the amount of nitrogen required to make up the balance. The paper also contains much excellent experimental data for a study of the mass action relations between nutrients and plants; for instance, the relation between nitrogen in the soil and nitrogen in the crop.—(*Inter. Sugar Jl.*, Vol. XL, No. 475, p. 278, 1938.)

* * *

Foaming of Condenser Water. *S. D. Agnihotri and S. H. Apte.*

Water from a barometric condenser that was re-circulated through a spray-pond was observed to foam to an inconvenient extent. The trouble was ascribed to accumulation of acid, due perhaps to fermentation of entrained sugar; it disappeared when alkaline river water (pH 7.4 to 8.1) was added to the circulating pond water. (*Facts About Sugar*, Vol. 33, No. 6, p. 35, 1938.)

ERRATUM

Opposite p. 181—Fig. 12. Plate printed up-side-down.

p. 193, Contents—Line 5—*For* Va ieties *read* Varieties
Line 9—*For* Deteriora on *read* Deterioration
Line 10—*For* M nor *read* Minor
Line 11—*For* Aspects o *read* Aspects of
Line 14—*For* Chem cal *read* Chemical

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Temperature and Health.

In normal circumstances, the heat production of the body is balanced by the heat loss, and the body temperature varies within narrow limits, but in industry there are many operations in which the workmen may have to face unduly high environmental temperatures. Heat production is caused mainly by muscular activity, while heat is lost by radiation, convection and evaporation of water in the form of sweat. When the external temperature is equal to or exceeds the body temperature, the only means of preventing rise of body temperature is by evaporation from the skin surface. Tolerance of high temperatures depends on the air being dry. Hence the wet-bulb temperature, and not the dry-bulb temperature, affords an indication of the limiting temperature that can be tolerated by man. In still air, having a wet-bulb temperature of about 88°F., a person at rest, wearing a minimum of clothing, can just maintain his body temperature constant. If the wet-bulb temperature exceeds 88°F., the body temperature begins to rise, but the effect is lessened if the subject be exposed to moving air currents which facilitate evaporation of the sweat. The performance of muscular work at high wet-bulb temperatures may cause a man to lose 3 lbs. or more of sweat per hour, and the loss of sodium chloride from the body is considerable. There is danger that if too much water is drunk the water/salt ratio in the body becomes appreciably altered and this causes undue exhaustion.

Heat-stroke is caused by high air temperatures accompanied by high relative humidity. Here again the wet-bulb temperature is the essential factor, for if this exceeds the tolerance limit, the body temperature begins to rise and continues to do so, since, once the body temperature rises much beyond normal limits, oxidation processes in the tissues are accelerated. The body temperature may rise to 108-110°F. or higher, and drastic measures may be required to reduce the body temperature if life is to be saved.—(From a Lecture by Dr. C. G. Douglas, F.R.S., *Journal Inst. Chem.* III, 1938.)

* * *

Cashew Oil and Mosquitoes.

The Haffkine Institute, Bombay, recently undertook an investigation to discover a suitable toxic substance which, added to the oil film, produced rapid death in a large number of larvae and pupae within as short a time as possible. It was found that the addition of cashew nut-shell oil to kerosene or high-speed Diesel oil increased their killing power three times when tested under laboratory conditions. This activation of the oil at the same time proportionately decreased the cost of the anti-mosquito measures. Working with larvae and pupae of *Armigeres obturans*, a culcine mosquito commonly occurring in Bombay, it was found that, while 3 ml. per square foot of kerosene oil alone was necessary to obtain a 100 per cent. kill, 1 ml. of a mixture of 5 parts of cashew nut-shell oil and 95 parts of kerosene or high-speed Diesel oil was adequate for the purpose. India at present holds a monopoly of cashew nut-shell oil, which is obtained as a by-product during the production of cashew nut kernels. The tree, *Anacardium occidentale*, originally introduced from South America, has well established itself in the coastal forests of India. The oil referred to above is used for painting wood, as a protection against insects, and is exported to America and Europe for paint mixtures.—(*Ind. Eng. Chem., News Edit.*, Vol. 16, No. 4, 1938, p. 110.)

* * *

The World's Reserves of Potash.

The most abundant source of potash is the sea, which contains 0.04 per cent. of potassium, an amount which, of course, is too small to permit economic recovery at present-day prices. Until recently, the German potash deposits at Stassfurt were the only dependable source of commercial potassium salts, but they now no longer comprise the sole supply. Suitable methods have been elaborated since the war for recovering potash from saline waters of Searle's Lake in California and the Dead Sea, and the development of deposits in New Mexico.

In Russia, the existence of potash deposits was unknown until after the Revolution, but rich deposits were discovered in 1925, so that by 1935, some 29,200 millions of tons of potash salts had been found to occur in the Soviet Union, which is several times greater than the estimated deposits of the rest of the world.—(Abstracted from "The Dissipation of Natural Resources" by P. H. V. Fielder, New Zealand Section of the Institute of Chemistry of Great Britain and Ireland, published in the Institute's Journal for April, 1938, pp. 168-180.)

* * *

Corrosion.

It is generally accepted that the primary mechanism of corrosion of immersed materials is electrochemical in character, but this also applies to many cases of atmospheric and soil corrosion. Atmospheric corrosion also includes the phenomena of tarnishing and direct oxidation, which are essentially metal-gas reactions. In immersed corrosion, films produced by the action of cathodically-formed alkali are important, as the distribution of such films has a predominant influence in determining the subsequent distribution of corrosion. Recent work on soil corrosion has confirmed the fact that cathodic depolarisation in neutral sulphate-containing media could be effected in the absence of oxygen through the agency of sulphate-reducing bacteria, which have the peculiar faculty of enabling mineral sulphates to act as hydrogen acceptors. This mechanism is important in the corrosion of cast-iron mains in impervious clay soils.—(From a Lecture by Dr. W. H. J. Vernon, *Journal Inst. Chem.* III, 1938.)

TREND OF THE MARKETS.

[The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.]

SUGAR.—Prices on the Home Markets have ranged as follows (c.i.f. per cwt.).

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
28th July	5	3¾	9	1½
4th August	5	4½	9	1½
11th August	5	3¾	9	1½
18th August	5	3¾	9	0¾
25th August	5	4½	9	0¾
1st September	5	5¼	9	2⅛
8th September	5	5¼	9	2⅛
15th September	5	7½	9	4½
(*16th September*, 1937)	6	5⅛	10	1½

The market has continued to show the inactivity which has characterised it during the last few weeks, and values have remained comparatively steady. The U.K. Board of Trade Returns for July show no change from last year's total import of 59,000 tons from Empire sources, small shipments from Natal being made up by the B.W.I.

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows:—

	Pence per lb.
27th July	7 13-16
3rd August	7 11-16
10th August	7 3-16
17th August	7 3-16
24th August	8 1-16
31st August	8
7th September	7 15-16
14th September	7 15-16
(*15th September*, 1937)	9

A moderate amount of buying has kept the market steady. More recently a distinctly firm tone has continued and prices have advanced further.

* * *

COCOA.—During the past month the cocoa market showed a slight firmness due to the refusal of the United States Government to allow 200 tons of poor quality Accra Cocoa to enter the Country. With such rejection of early shipments of Accra it appears likely that there will be further rejections over remainder of arrivals. Manufacturers generally have shown no inclination to follow market strength but show willingness to buy on all recessions. Good fermented Accra for September shipment is quoted at 22*s.* 6*d.* c.i.f. and locally Plantation Cocoa is quoted at $7.50 per fanega.—(*By Courtesy of the Cocoa Planters' Association of Trinidad, Ltd.*)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian Giza 7*	*F.G.F. Sakel.*
29th July	4.99	7.56	7.91
5th August	4.89	7.52	7.87
12th August	4.78	7.36	7.71
19th August	4.78	7.40	7.75
26th August	4.77	—	—
2nd September	4.85	—	—
9th September	4.72	—	—
16th September	4.81	—	—
(*17th Sept.*, 1937)	5.33	—	7.86

Although some business has been done, there have been no signs of any improvement in the market. The Sea Island market has been neglected, there being a few enquiries but no business.

* * *

LIME PRODUCTS. *Lime Oil.*—Handpressed continues to be nominally valued at 32*s.* 6*d.* per lb. There are sellers of Distilled at 18*s.* 6*d.* per lb., but the demand is slow. *Lime Juice.*—There is no demand for Concentrated and Raw is quietly steady at 1*s.* 9*d.* to 2*s.* 3*d.*, per gallon according to quality.—(*West India Committee Circular*, 11th August.)

* * *

BANANAS.—Prices have continued unchanged at £19 15*s.* per ton delivered London and £19 10*s.* nearest station Provinces for Jamaicas. Brazilians are 10*s.* lower at £15 10*s.* delivered London and £16 10*s.* Provinces. Imports into the U.K. for the fortnight ending 23rd July amounted to 1,104,814 bunches consigned by the following countries: Jamaica 993,692; Brazil 61,175; Canary Islands 29,631; Guatemala 14,850; Gold Coast 4,502; and Madeira 964.

* * *

GRAPEFRUIT.—Imports into the U.K. for the fortnight ending 23rd July amounted to 59,773 cwt. consigned by the following countries: South Africa 39,869; Portuguese East Africa 9,947; U.S.A. 6,644; Argentine 2,305; Brazil 509; France 302; Trinidad 148; Southern Rhodesia 45; and other countries 4.

* * *

COFFEE.—Blue Mountain Jamaicas were in some demand and up to 210*s.* was realised for best quality.

* * *

COPRA.—The market has been quiet and prices have declined, West Indian f.m.s. now being quoted at £10 17*s.* 6*d.* c.i.f. London.

PUBLICATIONS ISSUED BY THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

Journal.

"TROPICAL AGRICULTURE", the official monthly organ of the College. Vols. I to XIV (Vol. XV 1938, current Vol.).

Out of print :—Vol. I, Nos. 1, 5, 6 and 9; Vol. II, Nos. 1, 2, 3, 4, 8, 10 and 12; Vol. III, No. 1; Vol. IV, Nos. 1, and 2; Vol. V, Nos. 2 and 3; Vol. XIII, No. 7; Vol. XIV, No. 1.

Subscription Rates :—(British) 6*s*. ($1.44 Trinidad currency); (Foreign) 7*s*. 6*d*. ($1.80 Trinidad currency) per annum.

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Memoirs

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